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Global environmental and socio-economic impacts of selected alien grasses as a basis for ranking threats to South Africa

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Abstract

Decisions to allocate management resources should be underpinned by estimates of the impacts of biological invasions that are comparable across species and locations. For the same reason, it is important to assess what type of impacts are likely to occur where, and if such patterns can be generalised. In this paper, we aim to understand factors shaping patterns in the type and magnitude of impacts of a subset of alien grasses. We used the Generic Impact Scoring System (GISS) to review and quantify published impact records of 58 grass species that are alien to South Africa and to at least one other biogeographical realm. Based on the GISS scores, we investigated how impact magnitudes varied across habitats, regions and impact mechanisms using multiple regression. We found impact records for 48 species. *Cortaderia selloana* had the highest overall impact score, although in contrast to five other species (*Glyceria maxima*, *Nassella trichotoma*, *Phalaris aquatica*, *Polypogon monspeliensis*, and *Sorghum halepense*) it did not score the highest possible impact score for any specific impact mechanism. Consistent with other studies, we found that the most frequent environmental impact was through competition with native plant species (with 75% of cases). Socio-economic impacts were recorded more often and tended to be greater in magnitude than environmental impacts, with impacts recorded particularly often on agricultural and animal production (57% and 51% of cases respectively). There was variation across different regions and habitats in impact magnitude, but the differences were not statistically significant. In conclusion, alien grasses present in South Africa have caused a wide range of negative impacts across most habitats and

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regions of the world. Reviewing impacts from around the world has provided important information for the management of alien grasses in South Africa, and, we believe, is an important component of management prioritisation processes in general.

Keywords
alien grasses, environmental impact, GISS, impact assessment, impact magnitude, impact mechanism, socio-economic impact.

Introduction

Grasses (family Poaceae) are among the most introduced species around the world; they occur on every continent and in various habitat types (Linder et al. 2018, van Kleunen et al. 2015, Visser et al. 2016). Alien grasses are often introduced for their high economic value. They are the source for the most consumed staple foods in the world (cereal grains) (Prescott-Allen and Prescott-Allen 1990), pasturage for livestock in agriculture (Boval and Dixon 2012), energy through biofuels (Pimentel and Patzek 2005), and they are used in alcoholic beverages such as beer and whisky (Solange et al. 2014). Alien grasses have also, however, been introduced to new areas as transport contaminants and stowaways. For example, a study by Whinam et al. (2005) found that the major source of alien grass (such as *Agrostis stolonifera*) introductions into sub-Antarctic islands was the transport used for ship to shore food transfers.

Whether such introductions were accidental or deliberate, and regardless of the many benefits they provide, the introduction of alien grasses can result in invasions that cause substantial negative environmental and socio-economic impacts (Early et al. 2016, D'Antonio and Vitousek 1992, Driscoll et al. 2014). Grasses such as *Andropogon gayanus* have been reported to increase fire frequencies and intensity in fire-prone ecosystems (Rossiter-Rachor et al. 2004, Rossiter-Rachor et al. 2009, Setterfield et al. 2010). Arundo donax is known to change community structure, thereby causing habitat loss for birds and small mammals in the USA (Bell 1997). And in China, *Avena fatua* is reported to cause economic losses of US$500 million annually by invading agricultural land and reducing crop yields (Willenborg et al. 2005).

Less is known about how these impacts vary across different introduced ranges, but it has been suggested that some introduced ranges experience fewer recorded impacts from alien grasses due to context-dependent factors (Hulme et al. 2013); e.g. the level of grass invasions might track variation in fire regimes, or might be an artifact of how well studied invasions are (Visser et al. 2016). Either way, impacts of alien grasses are most likely still increasing due to factors such as climate change and propagule pressure (Chuine et al. 2012, Fensham et al. 2013). We therefore need to understand these impacts and take precautionary measures in order to prevent or reduce them (Hulme 2003, 2006, Keller and Perrings 2011). Impact assessments are cost-effective tools used to estimate the impacts of alien species and help in the decision-making process during the prioritization of limited resources (Jeschke et al. 2014, Kumschick

et al. 2012, Kumschick and Richardson 2013). Impact assessments have also been used to try to identify factors that predict impacts. Studies have found that traits such as a high fecundity, a habitat generalist strategy, a wide native range, a large body size and a large clutch size are associated with high environmental impacts for mammals, birds, and amphibians (Kumschick et al. 2013, Measey et al. 2016), and traits such as height, life form and life history are associated with greater impacts for plant species (Pyšek et al. 2012, Rumlerová et al. 2016). However, traits have generally been much more successful in predicting invasion success than in predicting impact magnitude. Moreover, impact magnitude has been found to be independent of invasion success (Ricciardi and Cohen 2007).

Similar to the 'invasive elsewhere' strategy of predicting invasion (Gordon et al. 2010), is the use of records of 'impact elsewhere' to quantify the potential impacts of alien species (Kumschick et al. 2015, Ricciardi 2003). This approach can be useful in predicting the impacts of species such as grasses with biased impact records, i.e. uneven research effort across their introduced ranges. This is because it allows species with limited information to be assessed, compared against other species, and be included in management strategies. Furthermore, the approach also facilitates the search for patterns related to the impact mechanisms and magnitudes, which can ultimately lead to a more predictive understanding of invasions.

Here we assess the environmental and socio-economic impacts of selected alien grasses occurring in South Africa by consolidating their impact records across their introduced ranges (e.g. see Kumschick et al. 2015 for examples of this for alien plants and animals in Europe, and Measey et al. 2016 for amphibians). We do this with the aim of providing quantitative estimates in order to determine which alien grasses have the greatest impacts, and to therefore assist decision makers when prioritising which alien grasses to manage. Furthermore, in order to improve our understanding of the likely impacts, we assess which factors contribute to an increased magnitude of impact in alien grasses by investigating habitats impacted by the species across different regions and determining the mechanisms through which impacts occur.

Methods

Species selection

There are approximately 256 alien grasses introduced into South Africa (Visser et al. 2017). Of these, we assessed impacts for the 58 species that occur as aliens in at least one of the other following regions: Australia, Chile, Europe or the USA. We adopted this approach because: (i) there is a limited number of studies of grass impacts in South Africa; (ii) these regions have a relatively large literature on alien grasses; and (iii) the regions are assumed to be representative of different major biogeographical realms across the world (Visser et al. 2016).

Literature search

We searched for relevant literature on the impacts caused by the selected alien grasses up to June 2016 using the Web of Science, Google Scholar, as well as biological invasion websites and databases such as Centre for Agriculture and Biosciences International (CABI) Invasive Species Compendium (www.cabi.org/isc), Invasive Species Specialist Group (ISSG) Global Invasive Species Database (www.iucngisd.org/gisd), Hawaiian Ecosystems at Risk project (HEAR) (www.hear.org), California Invasive Plant Council Inventory (www.cal-ipc.org). The grass species' scientific binomial names were used as search terms. We used synonyms and previous species names obtained from the Integrated Taxonomic Information System (ITIS) (www.itis.gov) as search terms for species with no literature record. We then selected relevant publications from the search results based on the titles and abstract content.

We used primary literature when possible, otherwise, we referred to the literature's reference list to acquire the cited literature, and the full reference to the cited literature was searched in Google Scholar. If we were still unable to access the primary literature, we noted this and recorded the primary literature as it is cited by the secondary source.

A total of 1300 published sources including >100 websites and databases were reviewed; 352 published references and 98 websites and databases were considered for the impact assessment (Appendix 1).

Impact scoring

Different methods have been developed to quantify the environmental and socio-economic impacts of alien species, with recent notable schemes including the Environmental Impact Classification for Alien Taxa (EICAT) (Hawkins et al. 2015) and the Socio-Economic Impact Classification for Alien Taxa (SEICAT) (Bacher et al. 2018). In this study, however, we chose to use the Generic Impact Scoring System (GISS) (Nentwig et al. 2016) (see Hagen and Kumschick 2018 for a comparison of the EICAT, SEICAT, and GISS schemes) as the GISS has been used widely to assess impacts of different species, and we wanted to relate our results with other previous assessments. The GISS classifies impacts into two major classes, namely (1) environmental and (2) socio-economic, with six impact mechanisms assigned for each impact class: (1.1) impacts on native plants or vegetation through mechanisms other than competition; (1.2) impacts on animals through predation, parasitism, or intoxication; (1.3) impacts on native species through competition; (1.4) impacts through transmission of diseases or parasites to native species; (1.5) impacts through hybridisation; (1.6) impacts on ecosystems (which includes changes in nutrient pools and fluxes, habitat modifications and changes in disturbance regimes); (2.1) impacts on agricultural production; (2.2) animal production; (2.3) forestry production; (2.4) human health; (2.5) human infrastructure and administration; and (2.6) human social life (Nentwig et al. 2016). For each impact mechanism a six-point ranked scale is used, ranging from zero (no impact detectable) to five (highest impact possible at a site) (Kumschick

et al. 2015). The GISS contains definitions and descriptions for the impact mechanisms and the impact scores within them. We assigned an impact mechanism and score to every recorded impact obtained according to the definitions and descriptions of the GISS. Scores can be summed over mechanisms to get a total score per species, with a maximum overall impact score of 60 (12 categories * a maximum impact score of 5 in each category—see details on the scoring system in Kumschick et al. 2015, Nentwig et al. 2016). In this study, we used the maximum impact score recorded per mechanism of each species for both environmental and socio-economic impacts to rank species (see Table 1). This method of aggregating only the maximum impacts per species per mechanism was used by Kumschick et al. (2015); we also adopted it in order to make our results comparable.

Because scores are based on published research, species that receive more research attention might be expected to have higher scores (Pyšek et al. 2008). Therefore, we tested the relationship between the species' overall impact scores and the number of published papers used per species using a Pearson correlation test (Kumschick et al. 2017). We also tested whether there is a correlation between the species' overall and maximum impact score in any one impact mechanism using a Kendall's tau correlation test.

Impacts across habitat types and regions

For each impact reference, we recorded the habitats where the impacts were said to occur, using the habitats classified according to the first level of the International Union for the Conservation of Nature (IUCN) Red List Habitat Classification Scheme (Version 3.1) (www.iucnredlist.org). In cases where the study was not in a natural habitat (e.g. greenhouse or laboratory) or the habitat was not stated, we recorded the habitat as 'not specified'.

We also noted the country where the impacts occurred for each impact recorded and determined whether the grass species was native or alien in that specific country. Impact records from the native range were excluded from further analyses. We did, however, retain cases where the country was not specified but the grass species was referred to as "alien", "introduced", or "non-native". We assigned each record to one of eight regions based on the location of the country in which the impacts were recorded. We used a Kendall's tau test to determine the correlation between the maximum impact of alien grasses in South Africa and the maximum impact elsewhere.

Statistical analysis

In contrast to the approach taken above to rank species, when testing the relationship between impact and habitats and region, we used the raw data on impact scores (i.e. each impact record was considered as a separate datum). The impact scores analysed here are therefore ordinal variables in which the scores are ordered (but which closely resemble a logarithmic scale). As such, we used a cumulative link mixed-effects model in the R package 'ordinal' (Christensen 2015) to test whether habitats and regions influ-

Table 1. Grasses alien to South Africa and one other region (Chile, Europe, Australia and the USA) ranked according to impacts. The numbers under environmental and socio-economic impacts are the respective sums of the maximum impact scores per impact mechanism of a species. Species that score a maximum of 5 in any one impact mechanism are highlighted in bold. NA indicates no impact found for that species, hence not applicable. Total impact represents the overall sum of the environmental and socio-economic impacts. Species marked with an asterisk* have impacts recorded in South Africa. Literature used and detailed maximum scores per mechanism are available in the Supporting Information (Appendix S1 and Table S1).

Species name	Environmental impacts	Socio-economic impacts	Total impact
*Cortaderia selloana**	7	11	18
*Arundo donax**	10	7	17
*Avena fatua**	10	7	17
*Elymus repens**	10	7	17
Festuca arundinacea	8	9	17
Nassella trichotoma*	**6**	**9**	**15**
Sorghum halepense*	**6**	**8**	**14**
Bambusa vulgaris	8	5	13
*Bromus tectorum**	7	8	13
Cortaderia jubata	7	8	13
Paspalum notatum	3	10	13
*Bromus rubens**	9	3	12
Glyceria maxima*	**4**	**8**	**12**
Brachypodium distachyon	9	2	11
Vulpia myuros	2	9	11
Holcus lanatus	7	3	10
*Hordeum murinum**	7	3	10
Paspalum dilatatum	2	8	10
Phalaris aquatica	**5**	**5**	**10**
*Agrostis stolonifera**	6	3	9
Arrhenatherum elatius	5	4	9
Bromus rigidus	2	7	9
Dactylis glomerate	3	6	9
Hordeum jubatum	4	5	9
*Poa annua**	5	4	9
Polypogon monspeliensis	**2**	**7**	**9**
Vulpia bromoides	5	4	9
Bromus madritensis	5	3	8
Lolium multiflorum	4	4	8
Aira caryophyllea	4	3	7
Avena barbata	6	1	7
*Bromus catharticus**	6	1	7
Lolium perenne	2	5	7
Poa pratensis	5	2	7
Briza maxima	6	NA	6
Bromus diandrus	NA	6	6
Digitaria sanguinalis	3	3	6
Lolium temulentum	2	4	6

Species name	Environmental impacts	Socio-economic impacts	Total impact
Paspalum urvillei	4	2	6
*Pennisetum setaceum**	5	1	6
Cenchrus spinifex	2	2	4
Cynosurus echinatus	4	NA	4
*Paspalum quadrifarium**	3	1	4
Avena sterilis	NA	3	3
Bromus hordeaceus	3	NA	3
Oryza sativa	2	NA	2
Panicum miliaceum	NA	2	2
*Pennisetum villosum**	1	1	2

ence impact magnitude. Since we found multiple studies that assess the same impacts for the same species in the same region or habitat, we included species identity, as well as mechanism nested in impact type (environmental or socio-economic) as random factors and impact mechanism, habitat type, and region as fixed effects. We also tested a model in which mechanism nested within impact type was included as a fixed effect but found this made no difference to the results. We did not investigate interactions among predictors because of the limited number of observations. To determine the goodness of fit for the model we calculated pseudo R^2 by fitting a null model with no predictor variables and compared it against the full model using the 'nagelkerke' function within the R package 'rcompanion' (Mangiafico 2016). We tested the significance of fixed effects using analysis of deviance of single-term deletion models tested against the full model using a chi-squared distribution from the 'drop1' command. We used least-squares means with P values adjusted using the Tukey method, to determine significant differences between the levels of each predictor (mechanism, habitat and region).

All statistical analyses were performed using R version 3.4.4 (R Core Team, 2018).

Results

Grasses ranked by impact

Of the 58 alien grasses selected for impact assessment, we found records of impact for 48 species, i.e. 10 species (Suppl. material 1: Table S1) were data deficient with no record of impact. The species with the highest overall impact score was *Cortaderia selloana* (impact magnitude = 18), followed by *Arundo donax*, *Avena fatua*, *Elymus repens*, and *Festuca arundinacea* (all with impacts of 17, Table 1). However, a different set of species scored the maximum possible impact of five on any one particular impact mechanism, namely, *Glyceria maxima* (animal production), *Nassella trichotoma* (animal production), *Phalaris aquatica* (predation or parasitism or intoxication and animal production), *Polypogon monspeliensis* (animal production), and *Sorghum halepense* (agricultural production) (see Suppl. material 1: Table S1).

Table 2. Cumulative link mixed effects model estimating the effect of habitat, region and impact mechanism on overall impact magnitude of the studied alien grasses (m1). The significance of predictor variables was determined using single-term (predictor) deletion models tested against the full model. Models were run with species identity, and mechanism nested within mechanism type (environmental or socio-economic) as random factors. AIC is the Alkaike's Information Criterion, and P is the chi-squared p-value.

Model	Df	AIC	P
m1		2203.4	
Habitats	9	2193.8	0.49
Regions	8	2202.5	0.06
Mechanisms	11	2219.3	< 0.001

We used a total of 352 published literature sources; however, the literature was highly skewed, ranging from one to 23 publications per species. Some literature sources reported on more than one species. We found a significant positive correlation (tau = 0.48, P = 0.006) between the overall impact scores per species and the number of publications used to score the impacts. However, this potentially only affects the relative rankings of species according to impact scores (Table 1), because for the mixed effect model analyses, we did not aggregate maximum records of the species and used each paper as a separate record.

Impact magnitudes across mechanisms

We found that three-quarters (36 out of 48) of alien grass species have records of causing environmental impacts through competition with native species, and half (24 out of 48) of the species have records of causing impacts on ecosystems (Figure 1). We found the fewest records and the lowest overall impact through the 'plants or vegetation' mechanism, which according to the GISS includes allelopathy or the release of plant exudates (Nentwig et al. 2016). Most socio-economic impacts are caused through agricultural and animal production, with 29 and 26 cases respectively, while forestry production was represented by few species (Figure 1). The maximum impact possible (5), was recorded for impacts on animals through predation or parasitism, animal production and agricultural production. When comparing scores between impact types, greater impact magnitudes of 4 and 5 were obtained for socio-economic than environmental impacts.

The effects of impact mechanisms, impacted regions, and habitat types on impact magnitude

We found that impact mechanism is the only statistically significant predictor of impact magnitude (P < 0.001, Table 2). Results from the model show that alien grasses have a lower impact magnitude through the transmission of diseases or parasites to native species and greater impacts on native animals through food availability or palatability and intoxication (Figure 2). There is a trend towards greater impact magnitude in Antarctica (Suppl. material 1: Figure S1); however, differences across regions are not significant (P = 0.057, Table 2). We found nine habitats impacted by alien grasses;

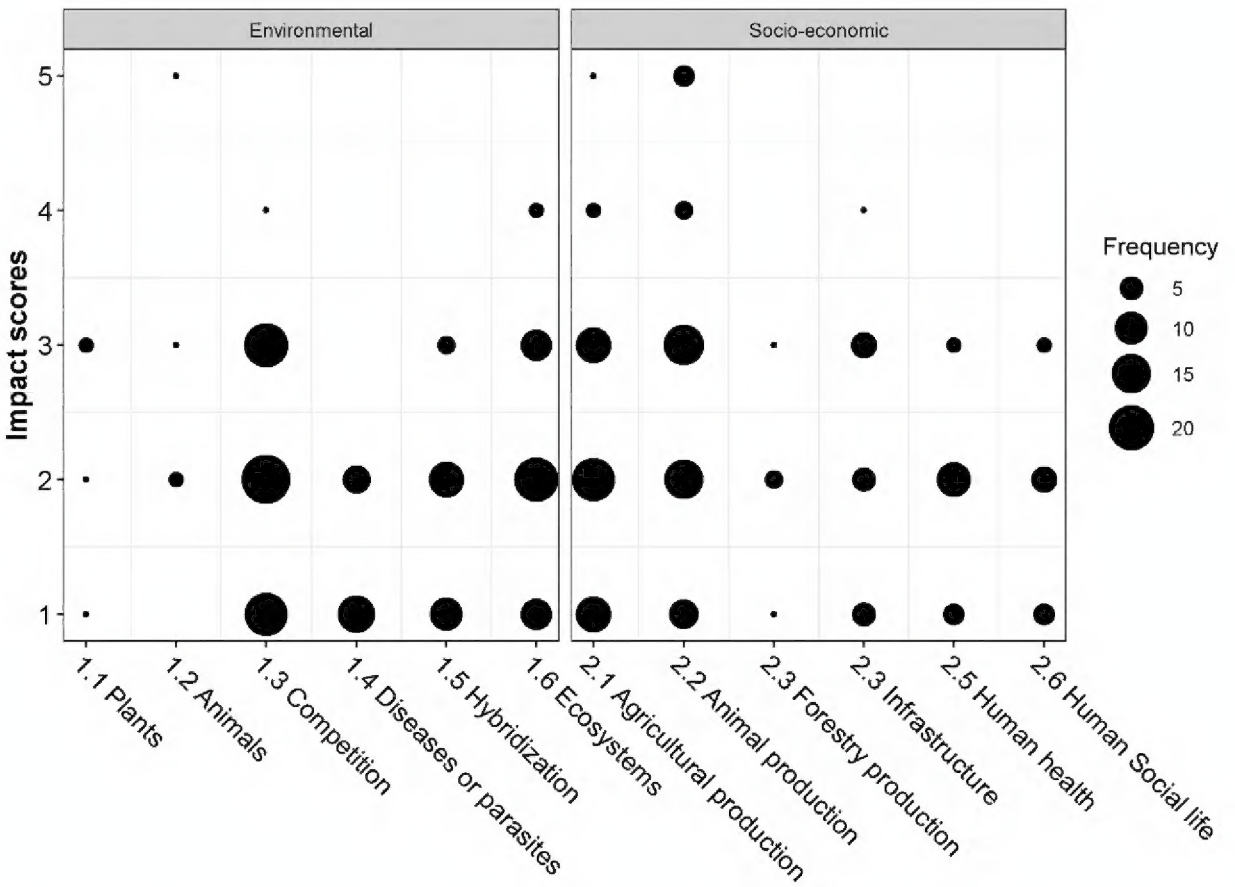

Figure 1. Number of alien grass species per impact mechanism for each impact magnitude. On the x-axis are the GISS environmental and socio-economic impact mechanisms, and on the y-axis are the impact scores according to GISS. The size of the points represents the number of species which had the corresponding maximum recorded impact score for that mechanism (out of the 48 species with impact records). See Suppl. material 1: Table S1 for the full details.

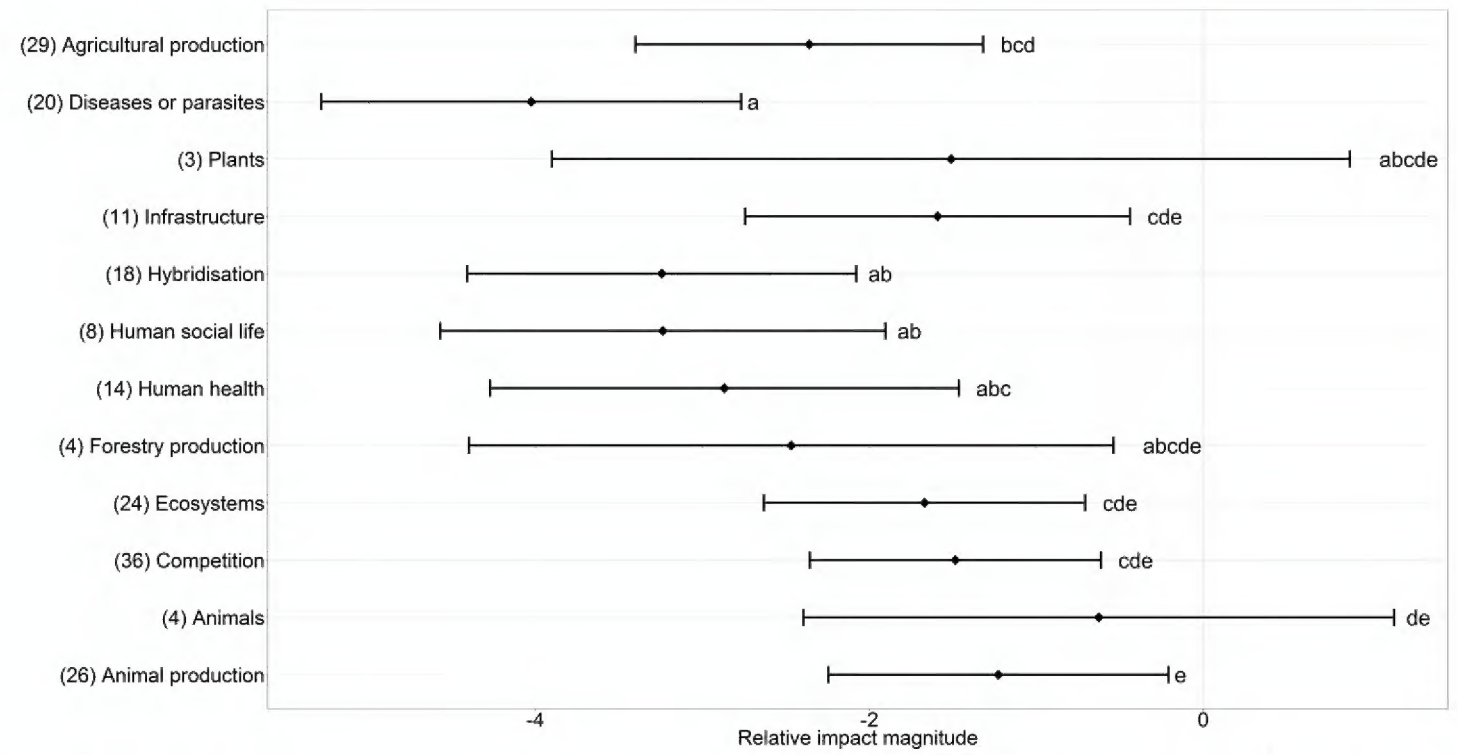

Figure 2. The impact magnitude of the 48 studied alien grasses across different impact mechanisms. On the x-axis are the least-squares means of the impact scores as derived from a cumulative link mixed effects model, and on the y-axis are the GISS impact mechanisms with the number of species in brackets. The points represent the impact magnitudes and the error bars represent 95% confidence intervals. Letters on the right side of the confidence intervals are level groupings indicating significant differences among the mechanisms (level groupings with the same letters are not significantly different, comparisons are Tukey adjusted).

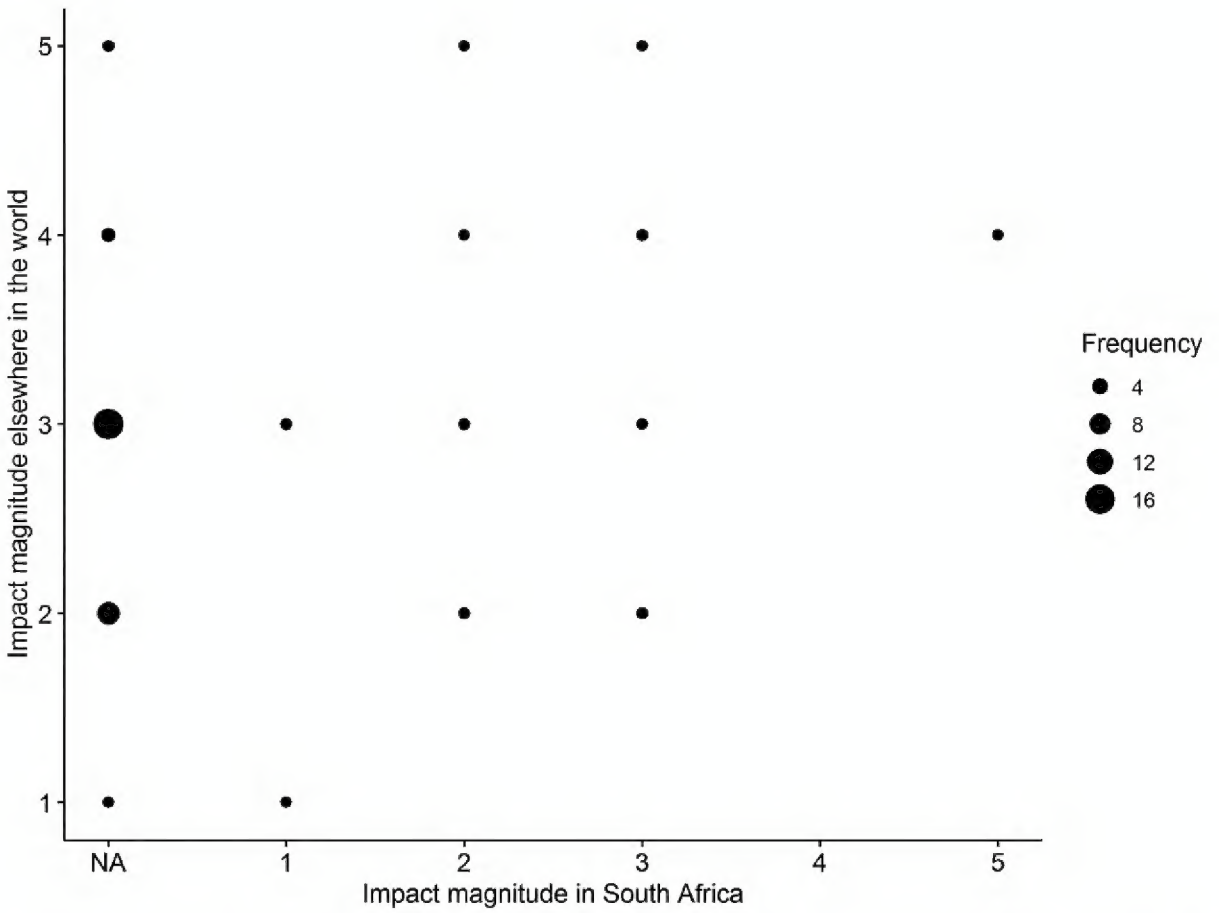

Figure 3. Comparison between impact magnitude of alien grasses in South Africa and elsewhere in the world. The values 1 to 5 on the x- and y-axis represent the GISS impact magnitudes and NA indicates no impact record found. The size of the points represents the frequency of species with impacts records.

however,as with "region" as a predictor of impact magnitude, habitat type was also not a significant predictor (P = 0.49, Table 2), and differences among habitats were not statistically significant (Suppl. material 2: Figure S2). Including mechanism nested within impact type (environmental or socio-economic) as a random effect provided no improvement in model fit (Suppl. material 1: Table S2). However, we kept this nested random effect in the analysis because it accounts and corrects for non-independence of the observations and reflects the actual design of this study.

Impact of alien grasses in South Africa versus elsewhere

We found that only 16 of the 58 alien grasses had recorded impacts in South Africa, 13 for inland and three for the offshore islands (Table 1). These impacts were mostly lower than elsewhere, with the exception of *Nassella trichotoma* and *Hordeum murinum* (Figure 3). However, there is no correlation (τ = 0.14, P = 0.28) between impacts of alien grasses in South Africa and those recorded elsewhere in the world.

Discussion

This study is the first environmental and socio-economic impact assessment to focus specifically on alien grasses. Using the GISS we were able to quantify the impacts of

alien grasses using information from across the globe. This study, therefore, provides a useful overview of the literature on evidence-based impacts of alien grasses and highlights potential risks to South Africa. Furthermore, it shows gaps in the available literature as some species could not be assessed due to a lack of impact studies.

We found that alien grasses generally scored higher for socio-economic than environmental impacts. Grass impact scores were particularly high for agricultural and animal production. This might reflect the large number of agricultural weeds that are grasses (Daehler 1998) or their initial introduction for agricultural purposes (Hancock 2012). Alien grasses scored the lowest for impacts caused via transmission of diseases or parasites to native species, with a maximum score of 2, which represents a minor impact (Nentwig et al. 2016), while the frequency under this mechanism was larger. On the contrary, mechanisms with scarce literature, such as impacts on native animals, obtained higher impact scores. This could be because impacts through the transmission of disease or parasites between plant species are not readily observed in the wild, most of the literature under this mechanism is form small-scale laboratory studies which do not report impacts on the overall population.

Despite most grasses not having very high overall impact scores compared to other species (e.g., Kumschick et al. 2015), many alien grasses scored high across the full range of impact mechanisms (i.e. alien grasses can cause a wide range of environmental and socio-economic impacts) and so had high total impact scores. For example, *Cortaderia selloana* did not have any individual mechanism score over 3 but has the highest overall score (Table 1) due to the many different mechanisms through which it causes impacts. In contrast, *Polypogon monspeliensis* and *Phalaris aquatica* scored the highest impact (5) in certain impact mechanisms, but their overall score is lower. This trend is not observed in other studies, such as the one conducted on alien aquatics by Laverty et al. (2015), where the species with the highest overall score also obtained an impact score of 5 for two different mechanisms. Grasses thus provide an interesting case to explore whether we should be more concerned with invasive species that cause a range of different types of impacts or invasive species that only cause a few types of impacts but with greater magnitude.

Grasses are one of the most cosmopolitan plant families in the world and are present in almost all terrestrial habitats. They also impact a wide range of habitats, as demonstrated in this study. Knowledge about which habitats are most severely impacted by alien grasses is essential for their management. Grasses can cause rapid and dramatic transformation of non-grassy habitats into grass-dominated communities. For example, *Bromus rubens* and *B. madritensis* have caused widespread transformation of shrubby systems in the Mojave Desert (DeFalco et al. 2007, Jurand et al. 2013). With regards to regions, we found that Antarctica (sub-Antarctic islands mostly) on average has the highest alien grass impact scores. Grasses such as *Agrostis stolonifera* reduce moss diversity, liverwort populations, and replace the rosaceous dwarf shrub (*Acaena magellanica*) with dense grassland patches on Marion Island (Gremmen et al. 1998). It is not clear, however, whether this trend is due to differences in sampling effort or a greater susceptibility of sub-Antarctic islands to impacts than the mainland (Hagen and Kumschick 2018).

However, neither habitat nor region were found to be significant predictors of impact magnitude. This could suggest that the impacts are the same across habitats and regions, but the lack of signal likely also reflects the low sample sizes for most habitat types and some regions. Furthermore, it will be interesting to repeat this study based on a more representative global sample of species (the bias in this current analysis towards grasses alien to South Africa was simply for applied reasons).

When we compare impacts scores of alien grasses with impact scores of studies that assessed other plant taxa (Kumschick et al. 2015, Rumlerová et al. 2016), our results also show that the competition with native plant species is the most frequent mechanism through which alien grasses cause impacts. Four species from our list were previously assessed in those studies (Kumschick et al. 2015, Rumlerová et al. 2016), and our results were similar to them for two of the species (*Arundo donax* and *Paspalum dilatatum*), each with a difference of less than 5 between the overall impact scores. However, we obtained higher overall impacts than Kumschick et al. (2015) and Rumlerová et al. (2016) for the other two species (*Cortaderia selloana* and *Hordeum jubatum*), each with a difference of 9 and 8 respectively. These differences can be explained by the broader search criteria applied; for example, authors of the above-mentioned studies used keywords such as "invas* or exot* or weed*" in addition to the species name, while we only used the species name as a search term.

Although impacts of alien grasses are poorly studied when compared to other species, such as birds and mammals, we were able to find impact records for more than 80% of the grass species selected for the assessment, which is higher than for other species, such as amphibians (41.3%) (Measey et al. 2016). The average number of papers (5.7) used to score impacts of alien grasses across the globe was also higher than the amphibians and other species (Kumschick et al. 2015, Measey et al. 2016). Similar to the mammals and other plants (Kumschick and Nentwig 2010, Kumschick et al. 2015), alien grasses were also reported to cause impact across all impact mechanisms. This might be because grasses occur across a wide range of sectors and habitats, which allows them to exert impact across all mechanisms. When prioritising management of all alien species, our list can be compared to other assessments conducted for other species, such as birds, amphibians, mammals, and aquatic species (Kumschick and Nentwig 2010, Laverty et al. 2015, Measey et al. 2016, Nentwig et al. 2010). However, it is important to note that impact assessments of some of those species are based on impacts recorded only in Europe and not globally, which may cause a bias to the overall impact scores. More impact studies are still needed for alien grass species, especially when it comes to species with no impact records across all introduced ranges, but with taxonomic characteristics of invaders (such as *Bambusa balcooa*, Canavan et al. 2016). It will be interesting to see if the findings of Canavan et al. (2018a), that bamboos have similar impacts in their native and alien ranges are the same for other grasses or perhaps only other tall-statured grasses (Canavan et al. 2018b). However, we suspect there are qualitative differences between the impacts in the native and alien ranges, for the grasses studied here, as the impacts observed are not primarily a response to human disturbance.

Two species were scored as causing very high impacts (4 or 5) outside of South Africa, but only low levels of impact (1 or 2) in South Africa. For instance, *Glyceria maxima* obtained

a score of 5 because it is associated with the death of livestock through poisoning in Australia (Barton et al. 1983), but such impacts have not (yet) been recorded in South Africa. This can flag species that could potentially cause high impacts in South Africa and which should therefore be monitored, or preventative measures put in place to limit such impacts occurring in future. In most other cases the impact elsewhere was either the same or slightly higher than that recorded in South Afica, except for *Agrostis stolonifera*, *Hordeum murinum*, and *Nassella trichotoma*. This included two species (*Nassella trichotoma* and *Hordeum murinum*) whose impacts in South Africa were one level higher than elsewhere. For example, *Nassella trichotoma* obtained a score of 5 in South Africa and 4 elsewhere (in Australia) for impacts on animal production by reducing livestock carrying capacity and pasture production (Klepeis et al. 2009). The lack of correlation between impacts found in South Africa and elsewhere should, however, be assessed with caution – it is indicative of a research gap. Records of impacts are generally fewer in South Africa (with a maximum of five sources per species and an average of 1.9) and even lacking for most species. Alternatively, it could indicate that there is an impact debt (Rouget et al. 2016), i.e. species have not reached their full impact potential in South Africa (yet), as species with more information in South Africa did not show higher similarities in impact magnitudes to elsewhere. Finally, South Africa might be more resilient to grass invasions, and impacts are actually lower here (Visser et al. 2017). These hypotheses warrant more research and can only be disentangled once more data become available.

In summary, the lack of statistically significant differences in impact magnitudes across habitats and regions for alien grasses suggests that impact in this group is not habitat or region specific as in other groups (cf. Hulme et al. 2013, Pyšek et al. 2011). As such, we recommend that different habitats should be equally considered for alien grass impact management. While we recommend that impact scoring schemes, such as the one used in this study, should be incorporated in the decision-making processes for alien species management, we caution that extrapolations from other invaded regions indicate potential and not actual impacts.

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References

Bacher S, Blackburn TM, Essl F, Genovesi P, Heikkilä J, Jeschke JM, Jones G, Keller R, Kenis M, Kueffer C, Martinou AF, Nentwig W, Pergl J, Pyšek P, Rabitsch W, Richardson DM, Roy HE, Saul WC, Scalera R, Vilà M, Wilson JRU, Kumschick S (2018) Socio-economic impact classification of alien taxa (SEICAT). Methods in Ecology and Evolution 9: 159–168. https://doi.org/10.1111/2041-210X.12844

Barton NJ, McOrist S, McQueen DS, O'Connor PF (1983) Poisoning of cattle by *Glyceria maxima*. Australian Veterinary Journal 60: 220–221. https://doi.org/10.1111/j.1751-0813.1983.tb09591.x

Bell GP (1997) Ecology and management of *Arundo donax*, and approaches to riparian habitat restoration in Southern California. In: Brock J (Ed.) Plant Invasions: Studies from North America and Europe. Backhuys, Leiden, 103–113.

Boval M, Dixon RM (2012) The importance of grasslands for animal production and other functions: a review on management and methodological progress in the tropics. Animal 6: 748–762. https://doi.org/10.1017/S1751731112000304

Canavan S, Kumschick S, Le Roux JJ, Richardson D, Wilson JRU (2018a) Does origin matter for impacts of weedy plants? Not for bamboos. Plants, People, Planet. http://dx.doi.org/10.1002/ppp3.5

Canavan S, Meyerson LA, Packer JG, Pyšek P, Maurel N, Lozano V, Richardson DM, Brundu G, Canavan K, Cicatelli A, Čuda J, Dawson W, Essl F, Guarino F, Guo W-Y, Kleunen M v, Kreft H, Lambertini C, Pergl J, Skálová H, Soreng RJ, Visser V, Vorontsova MS, Weigelt P, Winter M, Wilson JRU (2018b) Tall-statured grasses: a useful functional group for invasion science. Biological Invasions. https://doi.org/10.1007/s10530-018-1815-z.

Canavan S, Richardson DM, Visser V, Roux JJ Le, Vorontsova MS, Wilson JRU (2016) The global distribution of bamboos: assessing correlates of introduction and invasion. AoB PLANTS 9(1): plw078. https://doi.org/10.1093/aobpla/plw078

Christensen RHB (2015) Package "ordinal" Title Regression Models for Ordinal Data. Available from: https://cran.r-project.org/web/packages/ordinal/ordinal.pdf [accessed October 2, 2016]

Chuine I, Morin X, Sonié L, Collin C, Fabreguettes J, Degueldre D, Salager J-L, Roy J (2012) Climate change might increase the invasion potential of the alien C4 grass *Setaria parviflora* (Poaceae) in the Mediterranean Basin. Diversity and Distributions 18: 661–672. https://doi.org/10.1111/j.1472-4642.2011.00880.x

D'Antonio CM, Vitousek PM (1992) Biological invasions by exotic grasses, the grass/fire cycle, and global change. Annual Review of Ecology and Systematics 23: 63–87. https://doi.org/10.1146/annurev.es.23.110192.000431

Daehler CC (1998) The taxonomic distribution of invasive angiosperm plants: Ecological insights and comparison to agricultural weeds. Biological Conservation 84: 167–180. https://doi.org/10.1016/S0006-3207(97)00096-7

DeFalco LA, Fernandez GCJ, Nowak RS (2007) Variation in the establishment of a non-native annual grass influences competitive interactions with Mojave Desert perennials. Biological Invasions 9: 293–307. https://doi.org/10.1007/s10530-006-9033-5

Driscoll DA, Catford JA, Barney JN, Hulme PE, Inderjit, Martin TG, Pauchard A, Pyšek P, Richardson DM, Riley S, Visser V (2014) New pasture plants intensify invasive species risk. Proceedings of the National Academy of Sciences of the United States of America 111: 16622–16627. https://doi.org/10.1073/pnas.1409347111

Early R, Bradley BA, Dukes JS, Lawler JJ, Olden JD, Blumenthal DM, Gonzalez P, Grosholz ED, Ibañez I, Miller LP, Sorte CJB, Tatem AJ (2016) Global threats from invasive alien species in the twenty-first century and national response capacities. Nature Communications 7: 12485. https://doi.org/10.1038/ncomms12485

Fensham RJ, Donald S, Dwyer JM (2013) Propagule pressure, not fire or cattle grazing, promotes invasion of buffel grass *Cenchrus ciliaris* Sheppard. Journal of Applied Ecology 50: 138–146. https://doi.org/10.1111/1365-2664.12009

Gordon DR, Mitterdorfer B, Pheloung PC, Ansari S, Buddenhagen C, Chimera C, Daehler CC, Dawson W, Denslow JS, LaRosa AM, Nishida T, Onderdink DA, Panetta FD, Pysek P, Randall RP, Richardson MD, Tshidada NJ, Virtue JG, Williams PA (2010) Guidance for addressing the Australian weed risk assessment questions. EUROPE View project. Plant Production Quarterly 25: 56–74. http://scholar.sun.ac.za/handle/10019.1/46560

Gremmen NJM, Chown SL, Marshall DJ (1998) Impact of the introduced grass *Agrostis stolonifera* on vegetation and soil fauna communities at Marion Island, sub-Antarctic. Biological Conservation 85: 223–231. https://doi.org/10.1016/S0006-3207(97)00178-X

Hagen BL, Kumschick S (2018) The relevance of using various scoring schemes revealed by an impact assessment of feral mammals. NeoBiota 38: 35–75. https://doi.org/10.3897/neobiota.38.23509

Hancock J (2012) Plant evolution and the origin of crop species. 3rd ed. CABI, Nosworthy way, Wellingford, Oxfordshire, UK, 244 pp. https://doi.org/10.1079/9781845938017.0000

Hawkins CL, Bacher S, Essl F, Hulme PE, Jeschke JM, Kühn I, Kumschick S, Nentwig W, Pergl J, Pyšek P, Rabitsch W, Richardson DM, Vilà M, Wilson JRU, Genovesi P, Blackburn TM (2015) Framework and guidelines for implementing the proposed IUCN Environmental Impact Classification for Alien Taxa (EICAT). Diversity and Distributions 21: 1360–1363. https://doi.org/10.1111/ddi.12379

Hulme PE (2003) Biological invasions: winning the science battles but losing the conservation war? Oryx 37: 178–193. https://doi.org/10.1017/S003060530300036X

Hulme PE (2006) Beyond control: Wider implications for the management of biological invasions. Journal of Applied Ecology 43: 835–847. https://doi.org/10.1111/j.1365-2664.2006.01227.x

Hulme PE, Pyš Ek P, Ch V, Ík J, Pergl J, Schaffner U, Vilà M (2013) Bias and error in understanding plant invasion impacts. Trends in Ecology & Evolution 28: 212–218. https://doi.org/10.1016/j.tree.2012.10.010

Jeschke JM, Bacher S, Blackburn TM, Dick JTA, Essl F, Evans T, Gaertner M, Hulme PE, Kühn I, Mrugała A, Pergl J, Pyšek P, Rabitsch W, Ricciardi A, Richardson DM, Sendek A, Vilà M, Winter M, Kumschick S (2014) Defining the impact of non-native species. Conservation Biology 28: 1188–1194. https://doi.org/10.1111/cobi.12299

Jurand BS, Abella SR, Suazo AA (2013) Soil seed bank longevity of the exotic annual grass *Bromus rubens* in the Mojave Desert, USA. Journal of Arid Environments 94: 68–75. https://doi.org/10.1016/j.jaridenv.2013.03.006

Keller RP, Perrings C (2011) International Policy Options for Reducing the Environmental Impacts of Invasive Species. BioScience 61: 1005–1012. https://doi.org/10.1525/bio.2011.61.12.10

Klepeis P, Gill N, Chisholm L (2009) Emerging amenity landscapes: Invasive weeds and land subdivision in rural Australia. Land Use Policy 26: 380–392. https://doi.org/10.1016/j.landusepol.2008.04.006

Kumschick S, Nentwig W (2010) Some alien birds have as severe an impact as the most effectual alien mammals in Europe. Biological Conservation 143: 2757–2762. https://doi.org/10.1016/j.biocon.2010.07.023

Kumschick S, Bacher S, Dawson W, Heikkilä J, Sendek A, Pluess T, Robinson T, Kühn I (2012) A conceptual framework for prioritization of invasive alien species for management according to their impact. NeoBiota 15: 69–100. https://doi.org/10.3897/neobiota.15.3323

Kumschick S, Bacher S, Blackburn TM (2013) What determines the impact of alien birds and mammals in Europe? Biological Invasions 15: 785–797 https://doi.org/10.1007/s10530-012-0326-6

Kumschick S, Richardson DM (2013) Species-based risk assessments for biological invasions: Advances and challenges. Diversity and Distributions 19: 1095–1105. https://doi.org/10.1111/ddi.12110

Kumschick S, Bacher S, Evans T, Marková Z, Pergl J, Pyšek P, Vaes-Petignat S, van der Veer G, Vilà M, Nentwig W (2015) Comparing impacts of alien plants and animals in Europe using a standard scoring system. Journal of Applied Ecology 52: 552–561. https://doi.org/10.1111/1365-2664.12427

Kumschick S, Measey GJ, Vimercati G, de Villiers FA, Mokhatla MM, Davies SJ, Thorp CJ, Rebelo AD, Blackburn TM, Kraus F (2017) How repeatable is the Environmental Impact Classification of Alien Taxa (EICAT)? Comparing independent global impact assessments of amphibians. Ecology and Evolution 7: 2661–2670. https://doi.org/10.1002/ece3.2877

Laverty C, Nentwig W, Dick JTA, Lucy FE (2015) Alien aquatics in Europe: assessing the relative environmental and socioeconomic impacts of invasive aquatic macroinvertebrates and other taxa. Management of Biological Invasions 6: 341–350. https://doi.org/10.3391/mbi.2015.6.4.03

Linder HP, Lehmann CER, Archibald S, Osborne CP, Richardson DM (2018) Global grass (Poaceae) success underpinned by traits facilitating colonization, persistence and habitat transformation. Biological Reviews 93: 1125–1144. https://doi.org/10.1111/brv.12388

Mangiafico S (2016) Functions to Support Extension Education Program Evaluation [R package rcompanion version 1.1.3]. Available from: https://cran.r-project.org/web/packages/rcompanion/index.html

Measey GJ, Vimercati G, de Villiers FA, Mokhatla M, Davies SJ, Thorp CJ, Rebelo AD, Kumschick S (2016) A global assessment of alien amphibian impacts in a formal framework. Diversity and Distributions 22: 970–981. https://doi.org/10.1111/ddi.12462

Nentwig W, KÜhnel E, Bacher S (2010) A generic impact-scoring system applied to alien mammals in Europe: Contributed paper. Conservation Biology 24: 302–311. https://doi.org/10.1111/j.1523-1739.2009.01289.x

Nentwig W, Bacher S, Pyšek P, Vilà M, Kumschick S (2016) The generic impact scoring system (GISS): a standardized tool to quantify the impacts of alien species. Environmental Monitoring and Assessment 188: 315. https://doi.org/10.1007/s10661-016-5321-4

Pimentel D, Patzek TW (2005) Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower. Natural Resources Research 14: 65–67. https://doi.org/10.1007/s11053-005-4679-8

Prescott-Allen R, Prescott-Allen C (1990) How many plants feed the world? Conservation Biology 4: 365–374. https://doi.org/10.1111/j.1523-1739.1990.tb00310.x

Pyšek P, Richardson DM, Pergl J, Jarošík V, Sixtová Z, Weber E (2008) Geographical and taxonomic biases in invasion ecology. Trends in Ecology and Evolution 23: 237–244. https://doi.org/10.1016/j.tree.2008.02.002

Pyšek P, Jarošík V, Pergl J (2011) Alien plants introduced by different pathways differ in invasion success: unintentional introductions as a threat to natural areas. PLoS One 6: e24890. https://doi.org/10.1371/journal.pone.0024890

Pyšek P, Jarošík V, Hulme PE, Pergl J, Hejda M, Schaffner U, Vilà M (2012) A global assessment of invasive plant impacts on resident species, communities and ecosystems: the interaction of impact measures, invading species' traits and environment. Global Change Biology 18: 1725–1737. https://doi.org/10.1111/j.1365-2486.2011.02636.x

Ricciardi A (2003) Predicting the impacts of an introduced species from its invasion history: An empirical approach applied to zebra mussel invasions. Freshwater Biology 48: 972–981. https://doi.org/10.1046/j.1365-2427.2003.01071.x

Ricciardi A, Cohen J (2007) The invasiveness of an introduced species does not predict its impact. Biological Invasions 9: 309–315. https://doi.org/10.1007/s10530-006-9034-4

Rouget M, Robertson MP, Wilson JRU, Hui C, Essl F, Rentería JL, Richardson DM (2016) Invasion debt-quantifying future biological invasions. Diversity and Distributions 22: 445–456. https://doi.org/10.1111/ddi.12408

Rossiter-Rachor NA, Setterfield SA, Douglas MM, Hutley L, Cook G (2004) Exotic grass invasion in the tropical savanna of northern Australia: ecosystem consequences. In: Sindel BM, Johnson SB (Eds) Proceedings of the 14th Australian Weeds Conference: Weed Management, Wagga Wagga, NSW, 6–9 September 2004, 168–171.

Rossiter-Rachor NA, Setterfield SA, Douglas MM, Hutley LB, Cook GD, Schmidt S (2009) Invasive *Andropogon gayanus* (gamba grass) is an ecosystem transformer of nitrogen relations in Australian savanna. Ecological Applications 19: 1546–1560. https://doi.org/10.1890/08-0265.1

Rumlerová Z, Vilà M, Pergl J, Nentwig W, Pyšek P (2016) Scoring environmental and socioeconomic impacts of alien plants invasive in Europe. Biological Invasions 18: 3697–3711. https://doi.org/10.1007/s10530-016-1259-2

Setterfield SA, Rossiter-Rachor NA, Hutley LB, Douglas MM, Williams RJ (2010) Turning up the heat: The impacts of *Andropogon gayanus* (gamba grass) invasion on fire behaviour in northern Australian savannas. Diversity and Distributions 16: 854–861. https://doi.org/10.1111/j.1472-4642.2010.00688.x

Solange A, Georgette K, Gilbert F, Marcellin DK, Bassirou B (2014) Review on African traditional cereal beverages. American Journal of Research Communication 2. http://www.usa-journals.com/wp-content/uploads/2014/04/Solange_Vol25.pdf

van Kleunen M, Dawson W, Essl F, Pergl J, Winter M, Weber E, Kreft H, Weigelt P, Kartesz J, Nishino M, Antonova LA, Barcelona JF, Cabezas FJ, Cardenas D, Cardenas-Toro J, Castano N, Chacon E, Chatelain C, Ebel AL, Figueiredo E, Fuentes N, Groom QJ, Henderson L, Inderjit Kupriyanov A, Masciadri S, Meerman J, Morozova O, Moser D, Nickrent DL, Patzelt A, Pelser PB, Baptiste MP, Poopath M, Schulze M, Seebens H, Shu WS, Thomas J, Velayos M, Wieringa JJ, Pysek P (2015) Global exchange and accumulation of non-native plants. Nature 525: 100–103. https://doi.org/10.1038/nature14910

Visser V, Wilson JRU, Fish L, Brown C, Cook GD, Richardson DM (2016) Much more give than take: South Africa as a major donor but infrequent recipient of invasive non-native grasses. Global Ecology and Biogeography 25: 679–692. https://doi.org/10.1111/geb.12445

Visser V, Wilson JRU, Canavan K, Canavan S, Fish L, Le Maitre D, Nänni I, Mashau C, O'connor TG, Ivey P, Kumschick S, Richardson DM (2017) Grasses as invasive plants in South Africa revisited: Patterns, pathways and management. Bothalia-African Biodiversity & Conservation 47: 1–29. https://doi.org/10.4102/abc.v47i2.2169

Whinam J, Chilcott N, Bergstrom DM (2005) Subantarctic hitchhikers: expeditioners as vectors for the introduction of alien organisms. Biological Conservation 121: 207–219. https://doi.org/10.1016/J.BIOCON.2004.04.020

Willenborg CJ, May WE, Gulden RH, Lafond GP, Shirtliffe SJ (2005) Influence of wild oat (*Avena fatua*) relative time of emergence and density on cultivated oat yield, wild oat seed production, and wild oat contamination. Weed Science 53: 342–352. https://doi.org/10.1614/WS-04-124R1

Appendix 1

Literature, websites, and databases used to score environmental and socio-economic impacts of 58 alien grass species according to the GISS.

1. Abbasi FM, Shah AH, Perveen F, Afzal M, Sajid M, Masood R, Nawaz F (2010) Genomic affinity between *Oryza sativa* and *Oryza brachyantha* as revealed by in situ hybridization and chromosome pairing. African Journal of Biotechnology 9: 3068–3072.
2. Abella S, Fisichelli NA, Schmid SM, Embrey TM, Hughson D, Cipra J (2015) Status and management of non-native plant invasion in three of the largest national parks in the United States. Nature Conservation 10: 71–94. https://doi.org/10.3897/natureconservation.10.4407
3. Abella SR, Craig DJ, Chiquoine LP, Prengaman KA, Schmid SM, Embrey TM (2011) Relationships of Native Desert Plants with Red brome (*Bromus rubens*): Toward Identifying Invasion-Reducing Species. Invasive Plant Science and Management 4: 115–124. https://doi.org/10.1614/IPSM-D-10-00013.1
4. Acciaresi HA, Guiamet JJ (2010) Below- and above-ground growth and biomass allocation in maize and *Sorghum halepense* in response to soil water competition. Weed Research 50: 481–492. https://doi.org/10.1111/j.1365-3180.2010.00794.x
5. Actkinson JM, Burson BL (1999) Cytogenetic relationships between *Paspalum pubiflorum* and three South American Paspalum species. International journal of plant sciences 160: 775–781.
6. Adkins E, Cordell S, Drake DR (2011) Role of Fire in the Germination Ecology of Fountain Grass (*Pennisetum setaceum*), an Invasive African Bunchgrass in Hawai'i. Pacific Science 65: 17–25. https://doi.org/10.2984/65.1.017
7. Agarkova IV, Vidaver AK, Postnikova EN, Riley IT, Schaad NW (2006) Genetic Characterization and Diversity of *Rathayibacter toxicus*. Phytopathology 96: 1270–1277. https://doi.org/10.1094/PHYTO-96-1270

8. Aguiar FC, Ferreira MT, Albuquerque A, Bernez I (2005) Invasibility Patterns of Knotgrass (*Paspalum distichum*) in Portuguese Riparian Habitats. Weed Science Society of America and Allen Press Stable 19: 509–516.
9. Ahmad R, Okada M (2006) Isolation, characterization, and evaluation of microsatellite loci for cultivar identification in the ornamental pampas grass *Cortaderia selloana*. Journal of American Society for Horticultural Science 131: 499–505.
10. Alcantara R, Fernandez P, Smeda RJ, Alves PL, De Prado R (2016) Response of *Eleusine indica* and *Paspalum distichum* to glyphosate following repeated use in citrus groves Crop Protection 79: 1–7. https://doi.org/10.1016/j.cropro.2015.09.027
11. Allcock KG (2002) Effects of phosphorous on growth and competitve interactions of native and introduced species found in White Box woodlands. Austral Ecology 27: 638–646.
12. Allen VG, Segarra E (2001) Anti-quality components in forage: Overview, significance, and economic impact. Journal of Range Management 54: 409–412.
13. Almaghrabi OA (2012) Control of wild oat (*Avena fatua*) using some phenolic compounds I - Germination and some growth parameters. Saudi Journal of Biological Sciences 19: 17–24. https://doi.org/10.1016/j.sjbs.2011.07.005
14. An M, Pratley JE, Haig T (1997). Phytotoxicity of vulpia residues: I. Investigation of aqueous extracts. Journal of Chemical Ecology, 23(8), pp. 1979–1995.
15. Anđelković AA, Živković MM, Cvijanović DL, Novković MZ, Marisavljević DP, Pavlović DM, Radulović SB (2016) The contemporary records of aquatic plants invasion through the Danubian floodplain corridor in Serbia. Aquatic Invasions 11: 381–395. https://doi.org/10.3391/ai.2016.11.4.04
16. Anderson SJ, Stone CP, Higashino PK (1992) Distribution and spread of alien plants in Kipahulu Valley, Haleakala National Park, Above 2,300 ft elevation. Alien plant invasions in native ecosystems of Hawaii: management and research. University of Hawaii Cooperative National Park Resources Studies Unit, Honolulu 31: 300–38.
17. Andrivon D, De Vallavieille-Pope C (1992) Infection attempts of cultivated barley (*Hordeum vulgare*) with isolates of *Erysiphe graminis* collected from *Hordeum murinum* in southwestern Europe. Mycological Research 96: 1029–1032. https://doi.org/10.1016/S0953-7562(09)80111-1
18. Andújar D, Ribeiro A, Fernández-Quintanilla C, Dorado J (2013) Herbicide savings and economic benefits of several strategies to control *Sorghum halepense* in maize crops. Crop Protection 50: 17–23. https://doi.org/10.1016/j.cropro.2013.04.003
19. Ansari AA, Kihara TK, Marsh DG (1987) Immunochemical studies of *Lolium perenne* (rye grass) pollen allergens, Lol p I, II, and III. The Journal of Immunology 139: 4034–4041.
20. Antony M, Shukla Y, Janardhanan KK (2003) Potential risk of acute hepatotoxicity of kodo poisoning due to exposure to cyclopiazonic acid. Journal of Ethnopharmacology 87: 211–214. https://doi.org/10.1016/S0378-8741(03)00146-6
21. Anza M, Epelde L, Artetxe U, Becerril JM, Garbisu C (2016) Control of *Cortaderia selloana* with a glyphosate-based herbicide led to a short-term stimulation of soil fungal communities. Environmental Monitoring and Assessment 188: 1–6. https://doi.org/10.1007/s10661-016-5649-9

22. Arechavaleta M, Bacon CW, Plattner RD, Hoveland CS, Radcliffe DE (1992) Accumulation of ergopeptide alkaloids in symbiotic tall fescue grown under deficits of soil water and nitrogen fertilizer. Applied and Environmental Microbiology 58: 857–861.
23. Arise RO, Igunnu A, Malomo SO (2011) Effect of administration of aqueous extract of *Bambusa vulgaris* leaves on some biochemical variables of rat liver and serum. Journal of Medicinal Plants 5: 1622–1626.
24. Arriola PE, Ellstrand NC (1996) Crop-to-weed gene flow in the genus Sorghum (Poaceae): spontaneous interspecific hybridization between johnsongrass, *Sorghum halepense*, and crop sorghum, *S. bicolor*. American Journal of Botany83: 1153–1159.
25. Asay KH (1992) Breeding potentials in perennial Triticeae grasses. Hereditas 116: 167–173. https://doi.org/10.1111/j.1601-5223.1992.tb00223.x
26. Aslani MR, Pascoe I, Kowalski M, Michalewicz A, Retallick MAS, Colegate SM (2006) In vitro detection of hepatocytotoxic metabolites from Drechslera biseptata: A contributing factor to acute bovine liver disease? Australian Journal of Experimental Agriculture 46: 599–604. https://doi.org/10.1071/EA05204
27. Assadi AM, Runemark H, Systematics SP, September N (2017) Hybridisation, genomic constitution and generic. 194: 189–205.
28. Bacci B, Whiteley PL, Barrow M, Phillips PH, Dalziel J, El-Hage CM (2014) Chronic phalaris toxicity in eastern grey kangaroos (*Macropus giganteus*). Australian Veterinary Journal 92: 504–508. https://doi.org/10.1111/avj.12272
29. Bach T, Lam T, Iiyama K, Stone BA (1992) Cinnamic Acid Bridges Wheat and Between Cell Wall Polymers in Phalaris Internodes. Phytochemistry 31: 1179–1183. https://doi.org/10.1016/0031-9422(92)80256-E
30. Badgery WB, Kemp DR, Michalk DL, King WMCG (2005) Competition for nitrogen between Australian native grasses and the introduced weed *Nassella trichotoma*. Annals of Botany 96: 799–809. https://doi.org/10.1093/aob/mci230
31. Badgery WB, Kemp DR, Michalk DL, King WMG (2008) Studies of competition between *Nassella trichotoma* (Nees) Hack. ex Arechav. (serrated tussock) and native pastures. 2. Seedling responses. Australian Journal of Agricultural Research 59: 237–246. https://doi.org/10.1071/AR07113
32. Bakker EG, Montgomery B, Nguyen T, Eide K, Chang J, Mockler TC, Liston A, Seabloom EW, Borer ET (2009) Strong population structure characterizes weediness gene evolution in the invasive grass species *Brachypodium distachyon*. Molecular Ecology 18: 2588–2601. https://doi.org/10.1111/j.1365-294X.2009.04225.x
33. Balch JK, Bradley BA, D'Antonio CM, Gómez-Dans J (2013) Introduced annual grass increases regional fire activity across the arid western USA (1980–2009). Global Change Biology 19: 173–183. https://doi.org/10.1111/gcb.12046
34. Ball DA, Frost SM, Fandrich L, Tarasoff C, Mallory-Smith C (2008) Biological attributes of rattail fescue (*Vulpia myuros*). Weed Science 56: 26–31. https://doi.org/10.1614/WS-07-048.1
35. Barbosa JD, de Oliveira CMC, Duarte MD, Riet-Correa G, Peixoto PV, Tokarnia CH (2006) Poisoning of horses by bamboo, *Bambusa vulgaris*. Journal of Equine Veterinary Science 26: 393–398. https://doi.org/10.1016/j.jevs.2006.07.003

36. Barnes TG, Madison LA, Sole JD, Lacki MJ (1973) An Assessment of Habitat Quality for Northern Bobwhite in Tall Fescue-Dominated Fields. Source: Wildlife Society Bulletin 23: 231–237.
37. Barratt MG Moore JC (1959) On semisimplicial fibre-bundles. American Journal of Mathematics, 81: 639–657.
38. Barton NJ, McOrist S, McQueen DS, O'Connor PF (1983) Poisoning of cattle by *Glyceria maxima*. Australian Veterinary Journal 60: 220–221. https://doi.org/10.1111/j.1751-0813.1983.tb09591.x
39. Bastow JL, Preisser EL, Strong DR (2008) *Holcus lanatus* invasion slows decomposition through its interaction with a macroinvertebrate detritivore, *Porcellio scaber*. Biological Invasions 10: 191–199. https://doi.org/10.1007/s10530-007-9122-0
40. Beatley JC (1966) Ecological status of introduced brome grasses (*Bromus* spp.) in desert vegetation of southern Nevada. Ecology 47: 548–554.
41. Beckie HJ, Francis A, Hall LM (2012) The Biology of Canadian Weeds. 27. *Avena fatua* L. (updated). Canadian Journal of Plant Science 92: 1329–1357. https://doi.org/10.4141/cjps2012-005
42. Beckie HJ, Thomas AG, Legere A, Kelner DJ, Acker RCVAN, Meers S (1997) Nature, occurrence, and cost of Herbicide-Resistant Wild Oat (*Avena fatua*) in Small-Grain Production Areas. Weed Technology 13: 612–625.
43. Bell G (1997) Ecology and management of Arundo donax, and approaches to riparian habitat restoration in Southern California. Plant Invasions: Studies from North America and Europe: 103–113.
44. Bella S, D'Urso V (2012) First record in the Mediterranean basin of the alien leafhopper *Balclutha brevis* living on invasive *Pennisetum setaceum*. Bulletin of Insectology 65: 195–198.
45. Bennett AE, Thomsen M, Strauss SY (2011) Multiple mechanisms enable invasive species to suppress native species1. American Journal of Botany 98: 1086–1094. https://doi.org/10.3732/ajb.1000177
46. Berendse F, Elberse WT, Geerts RHME (1992) Competition and Nitrogen Loss from Plants in Grassland Ecosystems. Ecology 73: 46–53. https://doi.org/10.2307/1938719
47. Bertozzi T (2009) Zootaxa, *Anguina paludicola* sp. n. (Tylenchida: Anguinidae): The nematode associated. 46: 5326.
48. Bertozzi T, McKay AC (1995) Incidence on *Polypogon Monspeliensis* of *Clavibacter Toxicus* and *Anguina* sp., the Organisms Associated with 'Flood Plain staggers' in South Australia. Australian Journal of Experimental Agriculture 35: 567–569. https://doi.org/10.1071/EA9950567
49. Besr KF, BlurrNc, JD, lr.ro Bowss GG (1978) The biology of Canadian weeds. 3l. Hordeum jubatum L. Can. J. plant Sci. 58: 699–708.
50. Beyschlag W, Ryel RJ, Ullman I, Eckstein J (1996) Experimental studies on the competitive balance between two central european roadside grasses with different growth forms. Botanica Acta 109: 449–455.
51. Beyschlag W, Ryel RJ, Ullmann I (1992) Experimental and Modelling Studies of Competition for Light in Roadside Grasses. Botanica Acta 105: 285–291. https://doi.org/10.1111/j.1438-8677.1992.tb00300.x

52. Bhowmik PC, O'Toole BM, Andaloro J (1992) Effects of nicosulfuron on quackgrass (*Elytrigia repens*) control in corn (*Zea mays*). Weed Technology 6: 52–56.
53. Biganzoli F, Larsen C, Rolhauser AG (2013) Range expansion and potential distribution of the invasive grass *Bromus tectorum* in southern South America on the base of herbarium records. Journal of Arid Environments 97: 230–236. https://doi.org/10.1016/j.jaridenv.2013.07.006
54. Blackshaw RE, Semach G, Li X, Donovan JTO, Harker KN, Blackshaw RE, Semach G, Li X, Donovan JTO, Harker KN (2010) An Integrated Weed Management Approach to Managing Foxtail Barley (*Hordeum jubatum*) in Conservation Tillage Systems1. 13: 347–353.
55. Blossey B, Notzold R (1995) Evolution of increased competitive ability in invasive nonindigenous plants: a hypothesis. Journal of Ecology 83: 887–889.
56. Bodle, M (1998) Arundo the world in (at least) eighty ways. Wildland Weeds Vol. 1, Number 3.
57. Boland JM (2006) the Importance of Layering in the Rapid Spread of *Arundo Donax* (Giant Reed). Madroño 53: 303–312. https://doi.org/10.3120/0024-9637(2006)53[303:TIOLIT]2.0.CO;2
58. Boose, Holt (1999) Environmental effects on asexual reproduction in *Arundo donax*. Weed Research 39: 117–127. https://doi.org/10.1046/j.1365-3180.1999.00129.x
59. Borger CPD, Michael PJ, Mandel R, Hashem A, Bowran D, Renton M (2012) Linking field and farmer surveys to determine the most important changes to weed incidence. Weed Research 52: 564–574. https://doi.org/10.1111/j.1365-3180.2012.00950.x
60. Boshoff WHP (2002) Establishment, distribution, and pathogenicity of *Puccinia striiformis* f. sp. tritici in South Africa. The American Phytopathological Society 86: 485–492. https://doi.org/10.1094/PDIS.2002.86.5.485
61. Bourdôt GW, Hurrell GA, Saville DJ (1992) Eradication of nassella tussock (*Nassella trichotoma*), an unlikely outcome of grubbing. New Zealand Journal of Agricultural Research 35: 245–252. https://doi.org/10.1080/00288233.1992.10427501
62. Bourdôt GW, Saville DJ (2016) *Nassella trichotoma* in modified tussock grasslands in New Zealand: a case study in landscape-scale invasive plant population monitoring. Weed Research 56: 395–406. https://doi.org/10.1111/wre.12221
63. Bourke CA, Colegate SM, Rendell D, Bunker EC, Kuhn RP (2005) Peracute ammonia toxicity: A consideration in the pathogenesis of *Phalaris aquatica* 'Polioencephalomalacia-like sudden death'poisoning of sheep and cattle. Australian veterinary journal 83: 168–171.
64. Bourke CA, Hunt E, Watson R (2009) Fescue-associated oedema of horses grazing on endophyte-inoculated tall fescue grass (*Festuca arundinacea*) pastures. Australian Veterinary Journal 87: 492–498. https://doi.org/10.1111/j.1751-0813.2009.00519.x
65. Bourke CA, Rendell D, Colegate SM (2003) Clinical observations and differentiation of the peracute *Phalaris aquatica* poisoning syndrome in sheep known as Polioencephalo-malacia-like sudden death'. Australian veterinary journal 81: 698–700.
66. Bowers JE, Bean TM, Turner RM (2006) Two decades of change in distribution of exotic plants at the desert laboratory, Tucson, Arizona. Madroño 53: 252–263. https://doi.org/10.3120/0024-9637(2006)53[252:TDOCID]2.0.CO;2

67. Bradshaw, A.D., 1958. Natural Hybridization of Agrostis tenuis Sibth. and A. stolonifera L. New Phytologist, 57(1), pp. 66–84.
68. Brandsæter LO, Fogelfors H, Fykse H, Graglia E, Jensen RK, Melander B, Salonen J, Vanhala P (2010) Seasonal restrictions of bud growth on roots of *Cirsium arvense* and *Sonchus arvensis* and rhizomes of *Elymus repens*. Weed Research 50: 102–109. https://doi.org/10.1111/j.1365-3180.2009.00756.x
69. Bridges DC, Chandler JM (1987) Influence of johnsongrass (*Sorghum halepense*) density and period of competition on cotton yield. Weed Science 35: 63–67.
70. Brosnan JT, Henry GM, Breeden GK, Cooper T, Serensits TJ (2013) Methiozolin Efficacy for Annual Bluegrass (*Poa annua*) Control on Sand- and Soil-Based Creeping Bentgrass Putting Greens. Weed Technology 27: 310–316. https://doi.org/10.1614/WT-D-12-00123.1
71. Brown DE Minnich RA (986) Fire and changes in creosote bush scrub of the western Sonoran Desert, California. American Midland Naturalist 116: 411–422.
72. Brown HB (1916) Life History and Poisonous Properties of *Claviceps Paspali*. Journal of Agricultural Research 7: 401–407.
73. Campbell MH, Murison RD (1985) Effect of mixtures of tetrapion and 2, 2-DPA on the control of serrated tussock (*Nassella trichotoma*). Australian journal of experimental agriculture 25: 672–6.
74. Casto G (2017) Burrowing herbivore, precipitation, and plant community effects on invasive grass germination). Undergraduate Honors Theses. University of Colorado, Boulder. Availbable from: https://scholar.colorado.edu/cgi/viewcontent.cgi?article=2685&context=honr_theses (January 20, 2018).
75. Cawdell-Smith AJ, Scrivener CJ, Bryden WL (2010) Staggers in horses grazing paspalum infected with *Claviceps paspali*. Australian Veterinary Journal 88: 393–395. https://doi.org/10.1111/j.1751-0813.2010.00624.x
76. Cheeke PR (1995) Endogenous toxins and mycotoxins in forage grasses and their effects on livestock. Journal of animal science 73: 909–918. https://doi.org/10.2527/1995.733909x
77. Chown SL, Huiskes AHL, Gremmen NJM, Lee JE, Terauds A, Crosbie K, Frenot Y, Hughes KA, Imura S, Kiefer K, Lebouvier M, Raymond B, Tsujimoto M, Ware C, Van de Vijver B, Bergstrom DM (2012) Continent-wide risk assessment for the establishment of nonindigenous species in Antarctica. Proceedings of the National Academy of Sciences 109: 4938–4943. https://doi.org/10.1073/pnas.1119787109
78. Coffman GC, Ambrose RF, Rundel PW (2010) Wildfire promotes dominance of invasive giant reed (*Arundo donax*) in riparian ecosystems. Biological Invasions 12: 2723–2734. https://doi.org/10.1007/s10530-009-9677-z
79. Colegate SMA (2006) In vitro detection of hepatocytotoxic metabolites from *Drechslera biseptata*: a contributing factor to acute bovine liver disease? Australian Journal of Experimental Agriculture 46: 599–604.
80. Connor HE (1983) Cortaderia (Gramineae): Interspecific hybrids and the breeding system. Heredity, 51(1), pp. 395–403.

81. Cordell S, Sandquist DR (2008) The impact of an invasive African bunchgrass (*Pennisetum setaceum*) on water availability and productivity of canopy trees within a tropical dry forest in Hawaii. Functional Ecology 22: 1008–1017. https://doi.org/10.1111/j.1365-2435.2008.01471.x
82. Costas-Lippmann M (1979) Embryogeny of *Cortaderia selloana* and *C. jubata* (Gramineae). Botanical gazette, 140: 393–397.
83. Cowan TF, Sindel BM, Jessop RS, Browning JE (2007) Mapping the distribution and spread of *Nassella trichotoma* (serrated tussock) with a view to improving detectability, containment and eradication. Crop Protection 26: 228–231. https://doi.org/10.1016/j.cropro.2006.01.018
84. Crous PW, Wingfield MJ, Le Roux JJ, Richardson DM, Strasberg D, Shivas RG, Alvarado P, Edwards J, Moreno G, Sharma R, Sonawane MS, Tan YP, Altés A, Barasubiye T, Barnes CW, Blanchette RA, Boertmann D, Bogo A, Carlavilla JR, Cheewangkoon R, Daniel R, Nováková A, Oberlies NH, Otto EC, Paguigan ND, Pascoe IG (2015) Fungal Planet description sheets: 371 – 399. Persoonia: Molecular Phylogeny and Evolution of Fungi, 35, 264.
85. Crow W, Luc J, Sekora N, Pang W (2013) Interaction Between *Belonolaimus longicaudatus* and *Helicotylenchus pseudorobustus* on Bermudagrass and Seashore Paspalum Hosts.
86. Csurhes S, Markula A (2009) Weed risk assessment. Giant Reed Arundo donax. Brisbane: Department of Employment, Economic Development and Innovation.
87. Cudney DW, Jordan LS, Hall AE (1991) Effect of wild oat (*Avena fatua*) infestations on light interception and growth rate of wheat (*Triticum aestivum*). Weed Science 39: 175–179.
88. Cuevas L, Niemeyer HM (1993) Effect of hydroxamic acids from cereals on aphid cholinesterases. Phytochemistry 34: 983–985. https://doi.org/10.1016/S0031-9422(00)90698-8
89. Culvenor RAA, Reed KFMB, Mcdonald SEA (2005) Comparative levels of dimethyltryptamine- and tyramine-related alkaloid toxins in Australian cultivars and some wild populations of *Phalaris aquatica*. Australian Journal of Agricultural Research, 56: 1395–1403.
90. Curtis CA, Bradley BA (2015) Climate change may alter both establishment and high abundance of Red Brome (*Bromus rubens*) and African Mustard (*Brassica tournefortii*) in the semiarid Southwest United States. Invasive Plant Science and Management 8: 341–352. https://doi.org/10.1614/IPSM-D-14-00040.1
91. Cutulle MA, Derr JF, McCall D, Horvath B, Nichols AD (2013) Impact of hybrid bluegrass and tall fescue seeding combinations on brown patch severity and weed encroachment. HortScience 48: 493–500.
92. Daehler CC (2003) Performance comparisons of co-occurring native and alien invasive plants: implications for conservation and restoration. Annual Review of Ecology, Evolution, and Systematics, 34: 183–211. https://doi.org/10.1146/annurev.ecolsys.34.011802.132403
93. Davies JM (2014) Grass pollen allergens globally: The contribution of subtropical grasses to burden of allergic respiratory diseases. Clinical and Experimental Allergy 44: 790–801. https://doi.org/10.1111/cea.12317

94. Davies JM, Bright ML, Rolland JM, O'Hehir RE (2005) Bahia grass pollen specific IgE is common in seasonal rhinitis patients but has limited cross-reactivity with Ryegrass. Allergy: European Journal of Allergy and Clinical Immunology 60: 251–255. https://doi.org/10.1111/j.1398-9995.2005.00663.x
95. Davies JM, Li H, Green M, Towers M, Upham JW (2012) Subtropical grass pollen allergens are important for allergic respiratory diseases in subtropical regions. Clinical and Translational Allergy 2: 4. https://doi.org/10.1186/2045-7022-2-4
96. Davies JM, Mittag D, Dang TD, Symons K, Voskamp A, Rolland JM, O'Hehir RE (2008) Molecular cloning, expression and immunological characterisation of Pas n 1, the major allergen of Bahia grass *Paspalum notatum* pollen. Molecular Immunology 46: 286–293. https://doi.org/10.1016/j.molimm.2008.08.267
97. Davies KW, Nafus AM (2013) Exotic annual grass invasion alters fuel amounts, continuity and moisture content. International Journal of Wildland Fire 22: 353–358. https://doi.org/10.1071/WF11161
98. Davies LJ, Cohen D (1992) Phenotypic variation in somaclones of *Paspalum dilatatum* and their seedling offspring. Canadian Journal of Plant Science 72: 773–784. https://doi.org/10.4141/cjps92-093
99. De Bertoldi C, De Leo M, Ercoli L, Braca A (2012) Chemical profile of *Festuca arundinacea* extract showing allelochemical activity. Chemoecology 22: 13–21. https://doi.org/10.1007/s00049-011-0092-4
100. De Bustos A, Cuadrado A, Soler C, Jouve N (1996) Physical mapping of repetitive DNA sequences and 5S and 18S-26S rDNA in five wild species of the genus Hordeum. Chromosome Research 4: 491–499. https://doi.org/10.1007/BF02261776
101. De Falco LA, Fernandez GCJ, Nowak RS (2007) Variation in the establishment of a non-native annual grass influences competitive interactions with Mojave Desert perennials. Biological Invasions 9: 293–307. https://doi.org/10.1007/s10530-006-9033-5
102. De Sousa Moreira PF, Gangl K, De Assis Machado Vieira F, Ynoue LH, Linhart B, Flicker S, Fiebig H, Swoboda I, Focke-Tejkl M, Taketomi EA, Valenta R, Niederberger V (2015) Allergen microarray indicates Pooideae sensitization in Brazilian grass pollen allergic patients. PLoS ONE 10: 1–13. https://doi.org/10.1371/journal.pone.0128402
103. Denne T (1988) Economics of nassella tussock (*Nassella trichotoma*) control in New Zealand. Agriculture, ecosystems & environment 20: 259–278.
104. Dhima KV, Eleftherohorinos IG, Vasilakoglou IB (2000) Interference between *Avena sterilis*, *Phalaris minor* and five barley cultivars. Weed Research 40: 549–559.
105. DiTomaso JM, Drewitz JJ, Kyser GB (2008) Jubatagrass (*Cortaderia Jubata*) Control Using Chemical and Mechanical Methods. Invasive Plant Science and Management 1: 82–90. https://doi.org/10.1614/IPSM-07-028
106. Domènech R, Vilà M (2007) *Cortaderia selloana* invasion across a Mediterranean coastal strip. Acta Oecologica 32: 255–261. https://doi.org/10.1016/j.actao.2007.05.006
107. Domènech R, Vilà M, Gesti J, Serrasolses I (2006) Neighbourhood association of *Cortaderia selloana* invasion, soil properties and plant community structure in Mediterranean coastal grasslands. Acta Oecologica 29: 171–177. https://doi.org/10.1016/j.actao.2005.09.004

108. Domènech R, Vilà M, Pino J, Gesti J (2005) Historical land-use legacy and *Cortaderia selloana* invasion in the Mediterranean region. Global Change Biology 11: 1054–1064. https://doi.org/10.1111/j.1365-2486.2005.00965.x
109. Donald WW (1988) Established foxtail barley, *Hordeum jubatum*, control with glyphosate plus ammonium sulfate. Weed Technology 2: 364–368.
110. Donald WW (1990) Primary tillage for foxtail barley (*Hordeum jubatum*) control. Weed Technology 4: 318–321.
111. Dostálek J, Frantík T (2011) The impact of different grazing periods in dry grasslands on the expansive grass *Arrhenatherum elatius* L. and on woody species. Environmental Management 49: 855–861. https://doi.org/10.1007/s00267-012-9819-4
112. Dowling PM, Leys AR, Verbeek B, Millar GD, Lemerle D, Nicol HI (2004) Effect of annual pasture composition, plant density, soil fertility and drought on vulpia (*Vulpia bromoides* (L.) S.F. Gray). Australian Journal of Agricultural Research 55: 1097–1107. https://doi.org/10.1071/AR04032
113. Drake KK, Bowen L, Nussear KE, Esque TC, Berger AJ, Custer NA, Waters SC, Johnson JD, Miles AK, Lewison RL (2016) Negative impacts of invasive plants on conservation of sensitive desert wildlife. Ecosphere 7: 1–20. https://doi.org/10.1002/ecs2.1531
114. Drewitz JJ, Ditomaso JM, Drewitz JJ (2017) Seed Biology of Jubatagrass (*Cortaderia jubata*) Published by: Weed Science Society of America Seed biology of jubatagrass (*Cortaderia jubata*). 52: 525–530.
115. Eberwine Jr JW, Hagood Jr ES, Tolin, SA (1998) Quantification of viral disease incidence in corn (*Zea mays*) as affected by johnsongrass (*Sorghum halepense*) control. Weed technology 12: 121–127.
116. Eberwine JW, Hagood ES (1995) Effect of johnsongrass (*Sorghum halepense*) control on the severity of virus diseases of corn (Zea mays). Weed technology 9: 73–79.
117. Edgar JA (1994) Toxins in temperate grasses-implications and solutions. New Zealand Journal of Agricultural Research 37: 341–347. https://doi.org/10.1080/00288233.1994.9513072
118. Emam TM, Espeland EK, Rinella MJ (2014) Soil sterilization alters interactions between the native grass *Bouteloua gracilis* and invasive *Bromus tectorum*. Journal of Arid Environments 111: 91–97. https://doi.org/10.1016/j.jaridenv.2014.08.006
119. Evans RM, Thill DC, Tapia L, Shafii B, Lish JM (1991) Wild oat (Avena fatua) and spring barley (*Hordeum vulgare*) density affect spring barley grain yield. Weed Technology 5: 33–39.
120. Everitt JH, Yang C, Deloach CJ (2006) Remote Sensing of Giant Reed with QuickBird Satellite Imagery. Journal of Aquatic Plant Management 43: 81–85.
121. Evetts LL, Burnside OC (1975) Effect of early competition on growth of common milkweed. Weed Science 23: 1–3.
122. Eytcheson A (2011) Field sandbur (*Cenchrus spinifex*) control and bermudagrass (*Cynodon dactylon*) response to herbicide and nitrogen fertilizer treatments. PhD thesis. Oklahoma State University. Aavailable from: https://shareok.org/handle/11244/9323 (April 12, 2017).

123. Fahleson J, Okori P, Åkerblom-Espeby L, Dixelius C (2008) Genetic variability and genomic divergence of *Elymus repens* and related species. Plant Systematics and Evolution 271: 143–156. https://doi.org/10.1007/s00606-007-0623-1
124. Falloon RE (1976) Effect of infection by Ustilago bullata on vegetative growth of *Bromus catharticus*. New Zealand Journal of Agricultural Research 19: 249–254. https://doi.org/10.1080/00288233.1976.10426774
125. Fausey JC, Renner KA (1997) Germination, emergence, and growth of giant foxtail (*Setaria faberi*) and fall panicum (*Panicum dichotomiflorum*). Weed Science 45: 423–425. https://doi.org/10.1614/WS-06-139.1
126. Figueroa M, Alderman S, Garvin DF, Pfender WF (2013) Infection of *Brachypodium distachyon* by Formae Speciales of *Puccinia graminis*: Early Infection Events and Host-Pathogen Incompatibility. PLoS ONE 8: 1–9. https://doi.org/10.1371/journal.pone.0056857
127. Fleming TR, Maule AG, Martin T, Hainon-McDowell M, Entwistle K, McClure MA, Fleming CC (2015) A first report of *Anguina pacificae* in Ireland. Journal of Nematology 47: 97–104.
128. Flint JL, Barrett M (1989) Antagonism of glyphosate toxicity to johnsongrass (*Sorghum halepense*) by 2, 4-D and dicamba. Weed Science, 37: 700–705.
129. Follak S, Essl F (2013) Spread dynamics and agricultural impact of *Sorghum halepense*, an emerging invasive species in Central Europe. Weed Research 53: 53–60. https://doi.org/10.1111/j.1365-3180.2012.00952.x
130. Francis J (1993) Bambusa Vulgaris Schrad Ex Wendl: Common Bamboo: Gramineae. US Department of Agriculture, Forest Service, International Institute of Tropical Forestry.
131. Freckleton RP, Watkinson AR, Dowling PM, Leys AR (2000) Determinants of the abundance of invasive annual weeds: community structure and non-equilibrium dynamics. Proceedings of the Royal Society of London B: Biological Sciences 267: 1153-1161.
132. Frey L (2010) Grasses in Poland: invincible but threatened. Biodiversity: Research and Conservation 19: 93–102. https://doi.org/10.2478/v10119-010-0025-z
133. Fu R, Ashley RA (2006) Interference of large crabgrass (*Digitaria sanguinalis*), redroot pigweed (*Amaranthus retroflexus*), and hairy galinsoga (*Galinsoga ciliata*) with bell pepper. Weed Science 54: 364–372.
134. Gill GS, Bowran DG (1990) Tolerance of wheat cultivars to metribuzin and implications for the control of *Bromus diandrus* and *B. rigidus* in Western Australia. Australian Journal of Experimental Agriculture 30: 373–378. https://doi.org/10.1071/EA9900373
135. Gleichsner JA, Appleby AP (1996) Effects of vernalization on flowering in ripgut brome (*Bromus diandrus*). Weed science 44: 57–62.
136. Goergen E, Daehler CC (2001) Reproductive ecology of a native Hawaiian grass (*Heteropogon contortus; Poaceae*) versus its invasive alien competitor (*Pennisetum setaceum;* Poaceae). International Journal of Plant Sciences 162: 317–326.
137. Golder HM, Moss N, Rogers G, Jackson B, Gannon N, Wong PTW, Lean IJ (2017) Acute photosensitisation and mortality in a herd of dairy cattle in Tasmania. New Zealand Veterinary Journal 65: 39–45. https://doi.org/10.1080/00480169.2016.1232181

138. Gondo T, Tsuruta SI, Akashi R, Kawamura O, Hoffmann F (2005) Green, herbicide-resistant plants by particle inflow gun-mediated gene transfer to diploid bahiagrass (*Paspalum notatum*). Journal of Plant Physiology 162: 1367–1375. https://doi.org/10.1016/j.jplph.2005.03.005
139. González-Rodríguez AM, Baruch Z, Palomo D, Cruz-Trujillo G, Jiménez MS, Morales D (2010) Ecophysiology of the invader *Pennisetum setaceum* and three native grasses in the Canary Islands. Acta Oecologica 36: 248–254. https://doi.org/10.1016/j.actao.2010.01.004
140. Goolsby JA, Moran P (2009) Host range of Tetramesa romana Walker (Hymenoptera: Eurytomidae), a potential biological control of giant reed, *Arundo donax L.* in North America. Biological Control 49: 160–168. https://doi.org/10.1016/j.biocontrol.2009.01.019
141. Graham S (2013) Three cooperative pathways to solving a collective weed management problem. Australasian Journal of Environmental Management 20: 116–129. https://doi.org/10.1080/14486563.2013.774681
142. Graham S (2014) A new perspective on the trust power nexus from rural Australia. Journal of Rural Studies 36: 87–98. https://doi.org/10.1016/j.jrurstud.2014.06.010
143. Gremmen NJM, Chown SL, Marshall DJ (1998) Impact of the introduced grass *Agrostis stolonifera* on vegetation and soil fauna communities at Marion Island, sub-Antarctic. Biological Conservation 85: 223–231. https://doi.org/10.1016/S0006-3207(97)00178-X
144. Griffin JL, Miller DK, Salassi ME (2006) Johnsongrass (*Sorghum halepense*) control and economics of using glyphosate-resistant soybean in fallowed sugarcane fields. Weed technology 20: 980–985.
145. Griffith A, Loik M (2010) Effects of climate and snow depth on *Bromus tectorum* population dynamics at high elevation. Oecologia 164: 821–832. https://doi.org/10.1007/S00442-01
146. Grubb PJ (1982) Control of relative abundance in roadside Arrhenatheretum: results of a long-term garden experiment. The Journal of Ecology 70: 845–861.
147. Guérin-Marchand C, Sénéchal H, Bouin AP, Leduc-Brodard V, Taudou G, Weyer A, Peltre G, David B (1996) Cloning, sequencing and immunological characterization of Dac g 3, a major allergen from *Dactylis glomerata* pollen. Molecular immunology 33: 797–806.
148. Gunes E, Uludag A, Uremis I (2008) Economic impact of Johnsongrass (*Sorghum halepense* [L.] Pers.) in cotton production in Turkey. Journal of Plant Diseases and Proctection, Supplement: 515–520.
149. Guthrie G (2007) Impacts of the invasive reed *Arundo donax* on biodiversity at the community-ecosystem level. MSc Thesis. University of the Western Cape.Available from: http://etd.uwc.ac.za/handle/11394/2313 (April 23, 2017).
150. Hadfield J, Martin DP, Stainton D, Kraberger S, Owor BE, Shepherd DN, Lakay F, Markham PG, Greber RS, Briddon RW, Varsani A (2011) *Bromus catharticus* striate mosaic virus: A new mastrevirus infecting *Bromus catharticus* from Australia. Archives of Virology 156: 335–341. https://doi.org/10.1007/s00705-010-0872-0
151. Hashem A, Radosevich SR, Dick R (2000) Competition Effects on Yield, Tissue Nitrogen, and Germination of Winter Wheat (*Triticum aestivum*) and Italian Ryegrass

(*Lolium multiflorum*) Competition Effects on Yield, Tissue Nitrogen, and Germination of Winter Wheat (*Triticum aestivum*) and I. Weed Science 14: 718–725.

152. Hassan M, Širlová L, Vacke J (2014) Tall oatgrass mosaic virus (TOgMV): A novel member of the genus Tritimovirus infecting *Arrhenatherum elatius*. Archives of Virology 159: 1585–1592. https://doi.org/10.1007/s00705-013-1905-2
153. Hendrickson JR, Lund C (2010) Plant community and target species affect responses to restoration strategies. Rangeland Ecology & Management 63: 435–442.
154. Henry G, Burton J, Richardson R, Yelverton F (2008) Absorption and Translocation of Foramsulfuron in Dallisgrass (*Paspalum dilatatum*) Following Preapplication of MSMA. Weed Science 56: 785–788. https://doi.org/10.1614/WS-08-035.1
155. Henry GM, Burton MG, Yelverton FH (2009) Heterogeneous distribution of weedy paspalum species and edaphic variables in turfgrass. HortScience 44: 447–451.
156. Henry GM, Yelverton FH, Burton MG (2007) Dallisgrass (*Paspalum Dilatatum*) Control with Foramsulfuron in Bermudagrass Turf. Weed Technology 21: 759–762. https://doi.org/10.1614/WT-06-163.1
157. Herget ME, Hufford KM, Mummey DL, Mealor BA, Shreading LN (2015) Effects of competition with *Bromus tectorum* on early establishment of *Poa secunda* accessions: Can seed source impact restoration success? Restoration Ecology 23: 277–283. https://doi.org/10.1111/rec.12177
158. Herrera LP, Laterra P (2009) Do seed and microsite limitation interact with seed size in determining invasion patterns in flooding Pampa grasslands? Herbaceous Plant Ecology: Recent Advances in Plant Ecology: 93–105. https://doi.org/10.1007/978-90-481-2798-6_8
159. Hoskins AJ, Young BG, Krausz RF Russin JS (2005) Control of Italian ryegrass (*Lolium multiflorum*) in winter wheat. Weed technology 19: 261–265.
160. Houliston GJ, Goeke DF (2017) Cortaderia spp. In New Zealand: Patterns of genetic variation in two widespread invasive species. New Zealand Journal of Ecology 41: 107–112. https://doi.org/10.20417/nzjecol.41.13
161. Hsiao YH, Chen C, Willemse T (2016) Allergen sensitization patterns of allergic dogs: IgE-microarray analysis. Thai Journal of Veterinary Medicine 46: 235–242.
162. Huang Y, Kaminski JE, Landschoot PJ (2015) Regulation with Trinexapac-ethyl and Dew Removal at the Time of Fungicide Application Did Not Influence Dollar Spot Control. HortScience 50: 496–500.
163. Huxman TE, Hamerlynck EP Smith SD (1999) Reproductive allocation and seed production in *Bromus madritensis* ssp. *rubens* at elevated atmospheric CO_2. Functional Ecology 13: 769–777.
164. Ivany JA (1978). Effects of quack grass competition on silage corn yield. Canadian Journal of Plant Science 58: 539–542.
165. James A, Brown R, Basse B, Bourdôt GW, Lamoureaux SL, Roberts M, Saville DJ (2011) Application of a spatial meta-population model with stochastic parameters to the management of the invasive grass *Nassella trichotoma* in North Canterbury, New Zealand. Ecological Modelling 222: 1030–1037. https://doi.org/10.1016/j.ecolmodel.2010.11.031

166. Johnson BJ (1979) Bahiagrass (*Paspalum notatum*) and common lespedeza (*Lespedeza striata*) control with herbicides in centipedegrass (*Eremochloa ophiuroides*). Weed Science 27: 346–348.
167. Johnson WG, Frans RE, Parsch LD (1991) Economics of johnsongrass (*Sorghum halepense*) control in soybeans (*Glycine max*). Weed Technology 5: 765–770.
168. Johnston DJ, Reverter A, Robinson DL, Ferguson DM (2001) Sources of variation in mechanical shear force measures of tenderness in beef from tropically adapted genotypes, effects of data editing and their implications for genetic parameter estimation. Australian Journal of Experimental Agriculture 41: 991–996. https://doi.org/10.1071/EA97144
169. Jones LJ, Ostoja SM, Brooks ML, Hutten M (2015) Short-term Response of Holcus lanatus L. (*Common Velvetgrass*) to Chemical and Manual Control at Yosemite National Park, USA. Invasive Plant Science and Management 8: 262–268. https://doi.org/10.1614/IPSM-D-14-00060.1
170. Jones MA, Christians NE (2007) Mesotrione controls creeping bentgrass (*Agrostis stolonifera*) in Kentucky bluegrass. Weed Technology 21: 402–405. https://doi.org/10.1614/WT-05-181.1
171. Jones RE, Vere DT, Campbell MH (2000) The external costs of pasture weed spread: An economic assessment of serrated tussock control. Agricultural Economics 22: 91–103. https://doi.org/10.1016/S0169-5150(99)00043-2
172. Josic D, Delic D, Rasulic N, Stajkovic O, Kuzmanovic D, Stanojkovic A, Pivic R (2012) Indigenous pseudomonads from rhizosphere of maize grown on pseudogley soil in serbia. Bulgarian Journal of Agricultural Science 18: 197–206. https://doi.org/10.1007/sl
173. Juan VF, Monterroso L, Sacido MB, Cauhepe MA (2000) Postburning Legume Seeding in the Flooding Pampas, Argentina. Society for Range Management 53: 300–304. https://doi.org/10.2111/RANGELANDS-D-10-00090.1
174. Jurand BS, Abella SR (2013) Soil seed banks of the exotic annual grass bromus rubens on a burned desert landscape. Rangeland Ecology and Management 66: 157–163. https://doi.org/10.2111/REM-D-12-00106.1
175. Jurand BS, Abella SR, Suazo AA (2013) Soil seed bank longevity of the exotic annual grass *Bromus rubens* in the Mojave Desert, USA. Journal of Arid Environments 94: 68–75. https://doi.org/10.1016/j.jaridenv.2013.03.006
176. Kammerer SJ, Burpee LL, Harmon PF (2011) Identification of a New Waitea circinata Variety Causing Basal Leaf Blight of Seashore Paspalum. Plant Disease 95: 515–522. https://doi.org/10.1094/PDIS-03-10-0204
177. Kant R, Paulin L, Alatalo E, de Vos W m, Palva A (2011) Genome sequence of *Lacttobacillus amylovorus* GRL1118, isolated from pig ileum. Journal of bacteriology 193: 3147–3148. https://doi.org/10.1111/j.1751
178. Kavak H (2003) First record of leaf scald caused by *Rhynchosporium secalis* in a natural population of *Hordeum vulgare* ssp. *spontaneum* in Turkey. Plant Pathology 52: 805. https://doi.org/10.1111/j.1365-3059.2003.00914.x
179. Kavak H (2004) First record of spot blotch caused by *Bipolaris sorokiniana* on *Hordeum murinum* in Turkey. Canadian Journal of Plant Pathology 26: 205–206. https://doi.org/10.1080/07060660409507133

180. Kavanagh VB, Hall LM, Hall JC (2010) Potential hybridization of genetically engineered triticale with wild and weedy relatives in Canada. Crop Science 50: 1128–1140. https://doi.org/10.2135/cropsci2009.11.0644
181. Khan MA, Stace C a. (1999) Breeding relationships in the genus Brachypodium (Poaceae: Pooideae). Nordic Journal of Botany 19: 257–269. https://doi.org/10.1111/j.1756-1051.1999.tb01108.x
182. Kiecana I, Cegiełko M, Mielniczuk E, Pastucha A (2014) Fungi infecting ornamental grasses and the pathogenicity of *Fusarium culmorum* (WG Sm.) Sacc. and *Fusarium equiseti* (Corda) Sacc. to selected species. Acta Scientiarum Polonorum. Hortorum Cultus, 13: 61–75.
183. King SR, Hagood Jr ES (2003) The effect of johnsongrass (*Sorghum halepense*) control method on the incidence and severity of virus diseases in glyphosate-tolerant corn (*Zea mays*). Weed technology 17: 503–508.
184. Kisaka H, Kisaka M, Kanno A, Kameya T (1998) Intergeneric somatic hybridization of rice (*Oryza sativa* L.) and barley (*Hordeum vulgare* L.) by protoplast fusion. Plant cell reports 17: 362–367.
185. Kleemann SGL, Boutsalis P, Gill GS, Preston C (2016) Applications of pre-emergent pyroxasulfone, flufenacet and their mixtures with triallate for the control of *Bromus diandrus* (ripgut brome) in no-till wheat (*Triticum aestivum*) crops of southern Australia. Crop Protection 80: 144–148. https://doi.org/10.1016/j.cropro.2015.11.010
186. Kleemann SGL, Gill GS (2006) Differences in the distribution and seed germination behaviour of populations of *Bromus rigidus* and *Bromus diandrus* in South Australia: Adaptations to habitat and implications for weed management. Australian Journal of Agricultural Research 57: 213–219. https://doi.org/10.1071/AR05200
187. Kleemann SGL, Gill GS (2008) Applications of Metribuzin for The Control of Rigid Brome (*Bromus rigidus*) in No-Till Barley Crops of Southern Australia. Weed Technology 22: 34–37. https://doi.org/10.1614/WT-07-017.1
188. Kleemann SGL, Gill GS (2009) Population ecology and management of rigid brome (*Bromus rigidus*) in Australian cropping systems. Weed Science 57: 202–207. https://doi.org/10.1614/WS-08-121.1
189. Kleemann SGL, Gill GS (2009) The role of imidazolinone herbicides for the control of *Bromus rigidus* (rigid brome) in wheat in southern Australia. Crop Protection 28: 913–916. https://doi.org/10.1016/j.cropro.2009.07.005
190. Klepeis P, Gill N, Chisholm L (2009) Emerging amenity landscapes: Invasive weeds and land subdivision in rural Australia. Land Use Policy 26: 380–392. https://doi.org/10.1016/j.landusepol.2008.04.006
191. Kloppers, F. J., & Pretorius, Z. A. (1993). Bromus catharticus: a new host record for wheat stem rust in South Africa. Plant Disease, 77(10).
192. Knapp PA (1996) Cheatgrass (Bromus tectorum L) dominance in the Great Basin Desert: history, persistence, and influences to human activities. Global environmental change, 6(1), pp. 37–52.
193. Kopecký D, Loureiro J, Zwierzykowski Z, Ghesquière M, Doležel J (2006) Genome constitution and evolution in Lolium × Festuca hybrid cultivars (Festulolium). Theoretical and Applied Genetics 113: 731–742. https://doi.org/10.1007/s00122-006-0341-z

194. Kosmala A, Zwierzykowska E, Zwierzykowski Z (2006) Chromosome pairing in triploid intergeneric hybrids of *Festuca pratensis* with *Lolium multiflorum*, revealed by GISH. Journal of applied genetics 47: 215–220. https://doi.org/10.1007/BF03194626
195. Kostromytska OS, Koppenhöfer AM (2016) Responses of *Poa annua* and three bentgrass species (*Agrostis* spp.) to adult and larval feeding of annual bluegrass weevil, *Listronotus maculicollis* (Coleoptera: Curculionidae). Bulletin of Entomological Research 106: 729–739. https://doi.org/10.1017/S0007485316000468
196. Kulik MM, Dery PD (1995) The Infection of Festuca arundinacea by *Puccinia graminis* subsp. graminicola. Journal of Phytopathology 143: 53–58. https://doi.org/10.1111/j.1439-0434.1995.tb00200.x
197. Laffan SW (2006) Assessing regional scale weed distributions, with an Australian example using *Nassella trichotoma*. Weed Research 46: 194–206.
198. Lambrinos JG (2000) The impact of the invasive alien grass *Cortaderia jubata* (Lemoine) Stapf on an endangered mediterranean-type shrubland in California. Diversity and Distributions 6: 217–231. https://doi.org/10.1046/j.1472-4642.2000.00086.x
199. Lamoureaux SL, Basse B, Bourdôt GW, Saville DJ (2015) Comparison of management strategies for controlling *Nassella trichotoma* in modified tussock grasslands in New Zealand: A spatial and economic analysis. Weed Research 55: 449–460. https://doi.org/10.1111/wre.12158
200. Lamoureaux SL, Bourdôt GW, Saville DJ (2011) Population growth of *Nassella trichotoma* in grasslands in New Zealand slower today than in the past. Acta Oecologica 37: 484–494. https://doi.org/10.1016/j.actao.2011.06.008
201. Laterra P (1997). Post-burn recovery in the flooding Pampa: Impact of an invasive legume. Journal of Range Management 50: 274–277.
202. Laterra P, Solbrig OT (2001) Dispersal strategies, spatial heterogeneity and colonization success in fire-managed grasslands. Ecological Modelling 139: 17–29. https://doi.org/10.1016/S0304-3800(01)00227-7
203. Lean IJ (2001) Association between feeding perennial ryegrass (Lolium perenne cultivar Grasslands Impact) containing high concentrations of ergovaline, and health and productivity in a herd of lactating dairy cows. Australian Veterinary Journal 79: 262–264. https://doi.org/10.1111/j.1751-0813.2001.tb11978.x
204. Leduc-Brodard V, Inacio F, Jaquinod M, Forest E, David B, Peltre G (1996) Characterization of Dac g 4, a major basic allergen from *Dactylis glomerata* pollen. Journal of Allergy and Clinical Immunology 98: 1065–1072. https://doi.org/10.1016/S0091-6749(96)80193-X
205. Leffler AJ, Monaco TA, James JJ, Sheley RL (2016) Importance of soil and plant community disturbance for establishment of *Bromus tectorum* in the Intermountain West, USA. NeoBiota 30: 111–125. https://doi.org/10.3897/neobiota.30.7119
206. Leofanti GA, Camadro EL (2017) Pollen viability and meiotic abnormalities in brome grasses (*Bromus* L., section *Ceratochloa*) from Argentina. Turkish Journal of Botany 41: 127–133. https://doi.org/10.3906/bot-1607-46

207. Leys AR, Cullis BR, Plater B (1991) Effect of spraytopping applications of paraquat and glyphosate on the nutritive value and regeneration of Vulpia (*Vulpia bromoides* (L.) S.F. Gray]. Australian Journal of Agricultural Research 42: 1405–1415.
208. Leys AR, Plater B Lill WJ (1991) Response of vulpia (*Vulpia bromoides* (L.) SF Gray and *V. myuros* (L.) CC Gmelin) and subterranean clover to rate and time of application of simazine. Australian Journal of Experimental Agriculture, 31: 785–791.
209. Li R, Wang S, Duan L, Li Z, Christoffers MJ, Mengistu LW (2007) Genetic diversity of wild oat (*Avena fatua*) populations from China and the United States. Weed Sci 55: 95–101. https://doi.org/10.1614/WS-06-108.1
210. Li Y zhi, Cao Y, Zhou Q, Guo H ming, Ou G cai (2012) The Efficiency of Southern rice black-streaked dwarf virus Transmission by the Vector *Sogatella furcifera* to Different Host Plant Species. Journal of Integrative Agriculture 11: 621–627. https://doi.org/10.1016/S2095-3119(12)60049-5
211. Liu S, Vargas J, Merewitz E (2017) Phytohormones associated with bacterial etiolation disease in creeping bentgrass. Environmental and Experimental Botany 133: 35–49. https://doi.org/10.1016/j.envexpbot.2016.09.004
212. López-Granados F, Peña-Barragán JM, Jurado-Expósito M, Francisco-Fernández M, Cao R, Alonso-Betanzos A, Fontenla-Romero O (2008) Multispectral classification of grass weeds and wheat (*Triticum durum*) using linear and nonparametric functional discriminant analysis and neural networks. Weed Research 48: 28–37. https://doi.org/10.1111/j.1365-3180.2008.00598.x
213. Ma L, Vu GTH, Schubert V, Watanabe K, Stein N, Houben A, Schubert I (2010) Synteny between *Brachypodium distachyon* and *Hordeum vulgare* as revealed by FISH. Chromosome Research 18: 841–850. https://doi.org/10.1007/s10577-010-9166-3
214. Ma Y, Zhang M, Li Y, Shui J, Zhou Y (2014) Allelopathy of rice (*Oryza sativa* L.) root exudates and its relations with *Orobanche cumana* Wallr. and *Orobanche minor* Sm. germination. Journal of Plant Interactions 9: 722–730. https://doi.org/10.1080/17429145.2014.912358
215. Marshall GR, Coleman MJ, Sindel BM, Reeve IJ, Berney PJ (2016) Collective action in invasive species control, and prospects for community-based governance: The case of serrated tussock (*Nassella trichotoma*) in New South Wales, Australia. Land Use Policy 56: 100–111. https://doi.org/10.1016/j.landusepol.2016.04.028
216. Matocha MA, Grichar WJ, Grymes C (2010) Field Sandbur (*Cenchrus spinifex*) Control and Bermudagrass Response to Nicosulfuron Tank Mix Combinations. Weed Technology 24: 510–514. https://doi.org/10.1614/WT-D-10-00032.1
217. May C, Stewart PL (1998) Development of a toxin-binding agent as a treatment for tunicaminyluracil toxicity: protection against tunicamycin poisoning of sheep. Australian veterinary journal 76: 752–756. https://doi.org/10.1111/j.1751-0813.1998.tb12307.x
218. Mcgraw BA, Koppenhöfer AM (2015) Spatial analysis of *Listronotus maculicollis* immature stages demonstrates strong associations with conspecifics and turfgrass damage but not with optimal hosts on golf course fairways. Entomologia Experimentalis et Applicata 157: 307–316. https://doi.org/10.1111/eea.12363

219. McKay AC, Ophel KM, Reardon TB, Gooden JM (1993) Livestock deaths associated with *Clavibacter toxicus*/*Anguina* sp. infection in seedheads of *Agrostis avenacea* and *Polypogon monspeliensis*. Plant Disease 77: 635–641.
220. McKenzie EHC, Thongkantha S, Lumyong S (2007) *Zygosporium bioblitzi* sp. nov. on dead leaves of Cortaderia and Dracaena. New Zealand Journal of Botany 45: 433–435. https://doi.org/10.1080/00288250709509724
221. Mckinley TL, Roberts RK, Hayes RM English BC (1999) Economic comparison of herbicides for johnsongrass (*Sorghum halepense*) control in glyphosate-tolerant soybean (*Glycine max*). Weed technology13: 30–36.
222. McWhorter CG, Azlin WR (1978) Effects of environment on the toxicity of glyphosate to johnsongrass (*Sorghum halepense*) and soybeans (*Glycine max*). Weed Science 26: 605–608.
223. Mebalds MI, Price T V. (2010) Epidemiology of blind seed disease in perennial ryegrass (*Lolium perenne*) in Victoria. Australasian Plant Pathology 39: 394–405. https://doi.org/10.1071/AP10071
224. Mesléard F, Ham LT, Boy V, van Wijck C, Grillas P (1993) Competition between an introduced and an indigenous species: the case of *Paspalum paspalodes* (Michx) Schribner and *Aeluropus littoralis* (Gouan) in the Camargue (southern France). Oecologia 94: 204–209. https://doi.org/10.1007/BF00341318
225. Meyer SE, Quinney D, Nelson DL, Weaver J (2007) Impact of the pathogen *Pyrenophora semeniperda* on *Bromus tectorum* seedbank dynamics in North American cold deserts. Weed Research 47: 54–62. https://doi.org/10.1111/j.1365-3180.2007.00537.x
226. Michael PJ, Owen MJ, Powles SB (2010) Herbicide-resistant weed seeds contaminate grain sown in the Western Australian grain belt. Weed Science 58: 466–472.
227. Middleton BA, Shakla JB, Dubey B (1998) The water buffalo controversy in Keoladeo National Park, India. Ecological Modelling 106: 93–98. https://doi.org/10.1016/S0304-3800(97)00171-3
228. Milton SJ (2004) Grasses as invasive alien plants in South Africa. South African Journal of Science 100: 69–75.
229. Min AN (1997) Phytotoxicity of vulpia residues: I. Investigation of aqueous extracts. Journal of Chemical Ecology 23: 1979–1995. https://doi.org/10.1023/B:JOEC.0000006484.57119.84
230. Mitkowski NA, Browning M, Basu C, Jordan K, Jackson N (2005) Pathogenicity of *Xanthomonas translucens* from Annual Bluegrass on Golf Course Putting Greens. Plant Disease 89: 469–473. https://doi.org/10.1094/PD-89-0469
231. Miz RB, De Souza-Chies TT (2006) Genetic relationships and variation among biotypes of dallisgrass (*Paspalum dilatatum* Poir.) and related species using random amplified polymorphic DNA markers. Genetic Resources and Crop Evolution 53: 541–552. https://doi.org/10.1007/s10722-005-1290-0
232. Mokhtassi-Bidgoli A, Navarrete L, AghaAlikhani M, Gonzalez-Andujar JL (2013) Modelling the population dynamic and management of *Bromus diandrus* in a non-tillage system. Crop Protection 43: 128–133. https://doi.org/10.1016/j.cropro.2012.08.015

233. Molina-Montenegro MA, Carrasco-Urra F, Acuña-Rodríguez I, Oses R, Torres-Díaz C, Chwedorzewska KJ (2014) Assessing the importance of human activities for the establishment of the invasive *Poa annua* in Antarctica. Polar Research 33: 21425. https://doi.org/10.3402/polar.v33.21425
234. Molina-Montenegro MA, Carrasco-Urra F, Rodrigo C, Convey P, Valladares F, Gianoli E (2012) Occurrence of the Non-Native Annual Bluegrass on the Antarctic Mainland and Its Negative Effects on Native Plants. Conservation Biology 26: 717–723. https://doi.org/10.1111/j.1523-1739.2012.01865.x
235. Molina-Montenegro MA, Pertierra LR, Razeto-Barry P, Díaz J, Finot VL, Torres-Díaz C (2015) A recolonization record of the invasive *Poa annua* in Paradise Bay, Antarctic Peninsula: modeling of the potential spreading risk. Polar Biology 38: 1091–1096. https://doi.org/10.1007/s00300-015-1668-1
236. Monks DW, Schultheis JR (1998) Critical weed-free period for large crabgrass (*Digitaria sanguinalis*) in transplanted watermelon (*Citrullus lanatus*). Weed Science 46: 530–532.
237. Morales, J (2012). Patterns of Distribution of Paspalum species along environmental gradients landscapes in the Nicaraguan Dry Tropical Forest. Master's Thesis. Norwegian University of Science and Technology. Available from: https://brage.bibsys.no/xmlui/bitstream/handle/11250/245173/608831_FULLTEXT01.pdf?sequence=1 (October 23, 2017).
238. Morgan WG, King IP, Koch S, Harper JA, Thomas HM (2001) Introgression of chromosomes of *Festuca arundinacea* var. glaucescens into *Lolium multiflorum* revealed by genomic in situ hybridisation (GISH). Theoretical and Applied Genetics 103: 696–701. https://doi.org/10.1007/s001220100634
239. Morris C, Monaco T a., Rigby CW (2009) Variable Impacts of Imazapic Rate on Downy Brome (*Bromus tectorum*) and Seeded Species in Two Rangeland Communities. Invasive Plant Science and Management 2: 110–119. https://doi.org/10.1614/IPSM-08-104.1
240. Morrow LA, Stahlman PW (1984) The history and distribution of downy brome (*Bromus tectorum*) in North America. Weed Science 32: 2–6.
241. Mugdi LF, Goodall J, Witkowski ET Byrne, MJ (2015) The role of reproduction in Glyceria maxima invasion. African Journal of Range & Forage Science, 59–66.
242. Mugwedi LF, Goodall J, Witkowski ETF, Byrne MJ (2015) The role of reproduction in *Glyceria maxima* invasion. African Journal of Range and Forage Science 32: 59–66. https://doi.org/10.2989/10220119.2014.929177
243. Mugwedi LF, Goodall JM, Witkowski ETF, Byrne MJ (2015) Post-fire vegetative recruitment of the alien grass *Glyceria maxima* at a KwaZulu-Natal Midlands dam, South Africa. African Journal of Aquatic Science 40: 443–445. https://doi.org/10.2989/16085914.2015.1082069
244. Murry LE, Tai W (1980) Genome relations of *Agropyron sericeum*, *Hordeum jubatum* and their hybrids. American Journal of Botany 67: 1374–1379.
245. Musil CF, Milton SJ, Davis GW (2005) The threat of alien invasive grasses to lowland Cape floral diversity: An empirical appraisal of the effectiveness of practical control strategies. South African Journal of Science 101: 337–344.

246. Myer R, Blount A, Coleman S, Carter J (2011) Forage nutritional quality evaluation of Bahiagrass selections during autumn in Florida. Communications in Soil Science and Plant Analysis 42: 167–172. https://doi.org/10.1080/00103624.2011.535067
247. Najafabadi AS, Mofid MR, Solouki M, Mohammadi R (2010) Ergovaline levels in iranian ecotypes of *Festuca arundinacea* schreb. Trakia Journal of Sciences 8: 40–46.
248. Nasseri A. (2016). Canal Geometry, Flow Velocity, Dallisgrass (*Paspalum dilatatum Poir.*) Density and Soil Phosphorous Effects on Hydraulic Resistance of Vegetated Canals. Tarim Bilimleri Dergisi 22: 187–195.
249. Newingham BA, Belnap J (2006) Direct effects of soil amendments on field emergence and growth of the invasive annual grass *Bromus tectorum* L. and the native perennial grass *Hilaria jamesii* (Torr.) Benth. Plant and Soil 280: 29–40. https://doi.org/10.1007/s11104-005-8551-8
250. Newman YC, Sollenberger LE (2005) Grazing management and nitrogen fertilization effects on vaseygrass persistence in limpograss pastures. Crop Science 45: 2038–2043. https://doi.org/10.2135/cropsci2004.0736
251. Nishikawa T, Salomon B, Komatsuda T, von Bothmer R, Kadowaki K, Nishikawa T, Salomon B, Komatsuda T, von Bothmer R, Kadowaki K (2002) Molecular phylogeny of the genus Hordeum using three chloroplast DNA sequences. Genome 45: 1157–1166. https://doi.org/10.1139/G02-088
252. O'connor PJ, Covich AP, Scatena FN, Loope LL (2000) Non-indigenous bamboo along headwater streams of the Luquillo Mountains, Puerto Rico: leaf fall, aquatic leaf decay and patterns of invasion. Journal of Tropical Ecology, 16(04), pp. 499–516.
253. O'Donovan JT (1988) Wild oat (Avena fatua) infestations and economic returns as influenced by frequency of control. Weed Technology 2: 495–498.
254. Okada M, Lyle M, Jasieniuk M (2009) Inferring the introduction history of the invasive apomictic grass *Cortaderia jubata* using microsatellite markers. Diversity and Distributions 15: 148–157. https://doi.org/10.1111/j.1472-4642.2008.00530.x
255. Oliveira LB, Soares EM, Jochims F, Tiecher T, Marques AR, Kuinchtner BC, Rheinheimer DS, De Quadros FLF (2015) Long-Term Effects of Phosphorus on Dynamics of an Overseeded Natural Grassland in Brazil. Rangeland Ecology and Management 68: 445–452. https://doi.org/10.1016/j.rama.2015.07.012
256. Orgaard M, Anamthawat-Jónsson K (2001) Genome discrimination by in situ hybridization in Icelandic species of Elymus and Elytrigia (Poaceae: Triticeae). Genome 44: 275–283. https://doi.org/10.1139/gen-44-2-275
257. Owen MJ, Goggin DE, Powles SB (2012) Non-target-site-based resistance to ALS-inhibiting herbicides in six *Bromus rigidus* populations from Western Australian cropping fields. Pest Management Science 68: 1077–1082. https://doi.org/10.1002/ps.3270
258. Pablos I, Wildner S, Asam C, Wallner M, Gadermaier G (2016) Pollen Allergens for Molecular Diagnosis. Current Allergy and Asthma Reports 16. https://doi.org/10.1007/s11882-016-0603-z
259. Panayotou PC (1982) Some aspects on barley yellow dwarf virus host range/Einlge Aspekte zum Wirtspflanzenkreis des Gelbverzwergungs-Virus der Gerste. Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz/Journal of Plant Diseases and Protection 89: 595–603.

260. Papapanagiotou AP, Kaloumenos NS, Eleftherohorinos IG (2012) Sterile oat (*Avena sterilis* L.) cross-resistance profile to ACCase-inhibiting herbicides in Greece. Crop Protection 35: 118–126. https://doi.org/10.1016/j.cropro.2011.08.001
261. Parker-Allie F, Musil CF, Thuiller W (2009) Effects of climate warming on the distributions of invasive Eurasian annual grasses: A South African perspective. Climatic Change 94: 87–103. https://doi.org/10.1007/s10584-009-9549-7
262. Parkinson H, Zabinski C, Shaw N (2013) Impact of native grasses and cheatgrass (*Bromus tectorum*) on great basin forb seedling growth. Rangeland Ecology and Management 66: 174–180. https://doi.org/10.2111/REM-D-11-00028.1
263. Patra A, Tushar J, Dubey B (2017) Modeling and simulation of a wetland park: An application to Keoladeo National Park, India. Mathematics and Computers in Simulation 134: 54–78. https://doi.org/10.1016/j.matcom.2016.10.001
264. Patterson DT (1994) Temperature responses and potential range of the grass weed, serrated tussock (*Nassella trichotoma*), in the United States. Weed technology 8: 703–712.
265. Pereira MRR, Teixeira RN, Souza GSF, Silva JIC, Martins D (2011) Inibição do desenvolvimento inicial de plantas de girassol, milho e triticale por palhada de capim-colchão. Planta Daninha 29: 305–310. https://doi.org/10.1590/S0100-83582011000200008
266. Petersen G (1991) Intergeneric hybridization between Hordeum and Secale (Poaceae). I. Crosses and development of hybrids. Nordic Journal of Botany 11: 253–270. https://doi.org/10.1111/j.1756-1051.1991.tb01404.x
267. Philipson MN (1978) Apomixis in *Cortaderia jubata* (Gramineae). New Zealand Journal of Botany 16: 45–59. https://doi.org/10.1080/0028825X.1978.10429656
268. Picone LI, Quaglia G, Garcia FO, Laterra, P (2003). Biological and chemical response of a grassland soil to burning. Journal of Range Management 56: 291–297.
269. Popay I, Timmins SM, McCluggage T (2003) Aerial spraying of pampas grass in difficult conservation sites. Science for Conservation. Department of Conservation, Wellington, New Zealand: 5–17.
270. Poulin J, Sakai A, Weller SG, Nguyen T (2007) Plasticity, Precipitation, and Invasiveness in the Fire - Promoting Grass. American Journal of Botany 94: 533–541.
271. Poulin J, Weller SG, Sakai AK (2005) Genetic diversity does not affect the invasiveness of fountain grass (*Pennisetum setaceum*) in Arizona, California and Hawaii. Diversity and Distributions 11: 241–247. https://doi.org/10.1111/j.1366-9516.2005.00136.x
272. Puliafico KP, Schwarzländer M, Price WJ, Harmon BL, Hinz HL (2011) Native and Exotic Grass Competition with Invasive Hoary Cress (*Cardaria draba*). Invasive Plant Science and Management 4: 38–49. https://doi.org/10.1614/IPSM-D-10-00041.1
273. Qasem JR (2007) Chemical control of wild-oat (*Avena sterilis* L.) and other weeds in wheat (*Triticum durum* Desf.) in Jordan. Crop Protection 26: 1315–1324. https://doi.org/10.1016/j.cropro.2006.11.006
274. Quarín CL, Caponio I (1995) Cytogenetics and reproduction of *Paspalum dasypleurum* and its hybrids with *P. urvillei* and *P. dilatatum* ssp. flavescens. International Journal of Plant Sciences 156: 232–235.

275. Quinn LD, Holt JS (2008) Ecological correlates of invasion by *Arundo donax* in three southern California riparian habitats. Biological Invasions 10: 591–601. https://doi.org/10.1007/s10530-007-9155-4
276. Racelis AE, Goolsby JA, Moran P (2009) Seasonality and Movement of Adventive Populations of the Arundo Wasp (Hymenoptera: Eurytomidae), a Biological Control Agent of Giant Reed in the Lower Rio Grande Basin in South Texas. Southwestern Entomologist 34: 347–357. https://doi.org/10.3958/059.034.0401
277. Rahlao SJ, Milton SJ, Esler KJ, Barnard P (2010) The distribution of invasive *Pennisetum setaceum* along roadsides in western South Africa: The role of corridor interchanges. Weed Research 50: 537–543. https://doi.org/10.1111/j.1365-3180.2010.00801.x
278. Rahlao SJ, Milton SJ, Esler KJ, Barnard P (2014) Performance of invasive alien fountain grass (*Pennisetum setaceum*) along a climatic gradient through three South African biomes. South African Journal of Botany 91: 43–48. https://doi.org/10.1016/j.sajb.2013.11.013
279. Rahlao SJ, Milton SJ, Esler KJ, Van Wilgen BW, Barnard P (2009) Effects of invasion of fire-free arid shrublands by a fire-promoting invasive alien grass (*Pennisetum setaceum*) in South Africa. Austral Ecology 34: 920–928. https://doi.org/10.1111/j.1442-9993.2009.02000.x
280. Ray-Mukherjee J, Jones TA, Adler PB, Monaco TA (2011) Immature seedling growth of two north american native perennial bunchgrasses and the invasive grass bromus tectorum. Rangeland Ecology and Management 64: 358–365. https://doi.org/10.2111/REM-D-10-00101.1
281. Riefner Jr RE Columbus JT (2008) *Paspalum vaginatum* (Poaceae), a new threat to wetland diversity in southern California. Journal of the Botanical Research Institute of Texas 2: 743–759.
282. Riley IT (1996) *Dilophospora alopecuri* on *Lolium rigidum* and *Holcus lanatus* in southeastern Australia. Australasian Plant Pathology 25: 255–259.
283. Riley IT, Reardon TB, Bertozzi T (1998) Allozyme analysis of Australian isolates of *Dilophospora alopecuri*. Mycological Research 102: 301–307. https://doi.org/10.1017/S095375629700498X
284. Riley IT, Schmitz A, De Silva P (2001) *Anguina australis*, a vector for *Rathayibacter toxicus* in *Ehrharta longiflora*. Australasian Plant Pathology 30: 171–175. https://doi.org/10.1071/AP01024
285. Ringselle B, Prieto-Ruiz I, Andersson L, Aronsson H, Bergkvist G (2017) *Elymus repens* biomass allocation and acquisition as affected by light and nutrient supply and companion crop competition. Annals of botany 119: 477–485. https://doi.org/10.1093/aob/mcw228
286. Roberts AM, Van Ree R, Cardy SM, Bevan LJ, Walker MRC-1421683 (1992) Recombinant pollen allergens from *Dactylis glomerata*: preliminary evidence that human IgE cross-reactivity between Dac g II and Lol p I/II is increased following grass pollen immunotherapy. Immunology 76: 389–396.
287. Roché ACS (2010) New habitats, new menaces: *Centaurea* × *kleinii* (*C. moncktonii* × *C. solstitialis*), a new hybrid species between two alien weeds. Collectanea Botanica 23: 17–23. https://doi.org/10.3989/collectbot.2010.v29.002

288. Roehrs H, Klooss S, Kirleis W (2013) Evaluating prehistoric finds of *Arrhenatherum elatius* var. bulbosum in north-western and central Europe with an emphasis on the first Neolithic finds in Northern Germany. Archaeological and Anthropological Sciences 5: 1–15. https://doi.org/10.1007/s12520-012-0109-0
289. Rolston MP (1981) Wild oats in Newzealand: A review. New Zealand Journal of Experimental Agriculture 9: 115–121. https://doi.org/10.1080/03015521.1981.10427814
290. Rout ME, Chrzanowski TH (2009) The invasive *Sorghum halepense* harbors endophytic N2-fixing bacteria and alters soil biogeochemistry. Plant and Soil 315: 163–172. https://doi.org/10.1007/s11104-008-9740-z
291. Rúa MA, Umbanhowar J, Hu S, Burkey KO, Mitchell CE (2013) Elevated CO_2 spurs reciprocal positive effects between a plant virus and an arbuscular mycorrhizal fungus. New Phytologist 199: 541–549.
292. Ruttledge A, Whalley RDB, Reeve I, Backhouse DA, Sindel BM (2015) Preventing weed spread: A survey of lifestyle and commercial landholders about *Nassella trichotoma* in the Northern Tablelands of New South Wales, Australia. Rangeland Journal 37: 409–423. https://doi.org/10.1071/RJ15010
293. Salo LF (2004) Population dynamics of red brome (*Bromus madritensis* subsp. rubens): Times for concern, opportunities for management. Journal of Arid Environments 57: 291–296. https://doi.org/10.1016/S0140-1963(03)00110-1
294. Salo LF (2005) Red brome (*Bromus rubens* subsp. madritensis) in North America: Possible modes for early introductions, subsequent spread. Biological Invasions 7: 165–180. https://doi.org/10.1007/s10530-004-8979-4
295. Sarah S, Hussain F, Ehsan M, Burni T (2011) Allelopathic potential of *Polypogon monspeliensis* L. against two cultivars of wheat. African Journal of Biotechnology 10: 19723–19728. https://doi.org/10.5897/Ajb11.1528
296. Savova Bianchi D, Keller Senften J, Felber F (2002) Isozyme variation of *Hordeum murinum* in Switzerland and test of hybridization with cultivated barley. Weed Research 42: 325–333. https://doi.org/10.1046/j.1365-3180.2002.00292.x
297. Schmidt M, Bothma G (2006) Risk assessment for transgenic sorghum in Africa: Crop-to-crop gene flow in *Sorghum bicolor* (L.) Moench. Crop Science 46: 790–798. https://doi.org/10.2135/cropsci2005.06-0117
298. Schmidt W, Brubach M (1993) Plant-Distribution Patterns During Early Succession on an Artificial Protosoil. Journal of Vegetation Science 4: 247–254. https://doi.org/10.2307/3236111
299. Schramm G, Bufe A, Petersen A, Schlaak M, Becker WM (1998) Molecular and immunological characterization of group V allergen isoforms from velvet grass pollen (*Holcus lanatus*). Eur J Biochem 252: 200–206.
300. Schrauf GE, Blanco MA, Cornaglia PS, Deregibus VA, Madia M, Pacheco MG, Padilla J (2003) Ergot resistance in plants of *Paspalum dilatatum* incorporated by hybridisation with *Paspalum urvillei*. Tropical Grasslands 37: 182–186.
301. Scursoni JA, Palmano M, De Notta A, Delfino D (2012) Italian ryegrass (*Lolium multiflorum* Lam.) density and N fertilization on wheat (*Triticum aestivum* L.) yield in Argentina. Crop Protection 32: 36–40. https://doi.org/10.1016/j.cropro.2011.11.002

302. Scursoni JA, Satorre EH (2005) Barley (*Hordeum vulgare*) and wild oat (*Avena fatua*) competition is affected by crop and weed density. Weed technology 19: 790–795.
303. Severns PM (2008) Exotic grass invasion impacts fitness of an endangered prairie butterfly, *Icaricia icarioides fenderi*. Journal of Insect Conservation 12: 651–661. https://doi.org/10.1007/s10841-007-9101-x
304. Sezen UU, Barney JN, Atwater DZ, Pederson GA, Pederson JF, Chandler JM, Cox TS, Cox S, Dotray P, Kopec D, Smith SE, Schroeder J, Wright SD, Jiao Y, Kong W, Goff V, Auckland S, Rainville LK, Pierce GJ, Lemke C, Compton R, Phillips C, Kerr A, Mettler M, Paterson AH (2016) Multi-phase US spread and habitat switching of a post-columbian invasive, *Sorghum halepense*. PLoS ONE 11: 1–15. https://doi.org/10.1371/journal.pone.0164584
305. Sharma A, Sharma N, Bhalla P, Singh M (2017) Comparative and evolutionary analysis of grass pollen allergens using *Brachypodium distachyon* as a model system. PLoS ONE 12: 1–22. https://doi.org/10.1371/journal.pone.0169686
306. Sharma MP, Vandenborn WH (1978) The Biology of Canadian Weeds: Avena fatua. Canada Journal Plant Science 58: 141–157. https://doi.org/10.4141/cjps78-022
307. Shearer BL, Skovmand B, Wilcoxson RD (1977) *Hordeum jubatum* as a source of inoculum of *Septoria avenae* f. sp. *triticea* and *S. passerinii*. Phytopathology 67: 1338–1341.
308. Showler AT, Moran PJ (2014) Associations between host plant concentrations of selected biochemical nutrients and Mexican rice borer, *Eoreuma loftini*, infestation. Entomologia Experimentalis et Applicata 151: 135–143. https://doi.org/10.1111/eea.12177
309. Shu WS, Ye ZH, Lan CY, Zhang ZQ, Wong MH (2002) Lead, zinc and copper accumulation and tolerance in populations of *Paspalum distichum* and *Cynodon dactylon*. Environmental Pollution 120: 445–453. https://doi.org/10.1016/S0269-7491(02)00110-0
310. Shukla JB, Dubey B (1996) Effect of changing habitat on species: application to Keoladeo National Park, India. Ecological Modelling 86: 91–99. https://doi.org/10.1016/0304-3800(94)00194-4
311. Sierota Z, Damszel M, Borys M, Nowakowska JA (2016) The couch grass rhizome with *Heterobasidion annosum* fruiting bodies in afforested post-agricultural land. Forest Pathology 46: 376–379. https://doi.org/10.1111/efp.12289
312. Skerritt JH, Guihot SL, McDonald SE, Culvenor RA (2000) Development of immunoassays for tyramine and tryptamine toxins of *Phalaris aquatica* L. Journal of Agricultural and Food Chemistry 48: 27–32. https://doi.org/10.1021/jf990452z
313. Smith AE (1983) Differential bahiagrass (*Paspalum notatum*) cultivar response to atrazine. Weed Science 31: 88–92.
314. Smith MW, Wolf ME, Cheary BS, Carroll BL (2001) Allelopathy of bermudagrass, tall fescue, redroot pigweed, and cutleaf evening primrose on pecan. HortScience 36: 1047–1048.
315. Snow AA (2012) Illegal gene flow from transgenic creeping bentgrass: The saga continues. Molecular Ecology 21: 4663–4664. https://doi.org/10.1111/j.1365-294X.2012.05695.x
316. Sorrell BK, Brix H, Fitridge I, Konnerup D, Lambertini C (2012) Gas exchange and growth responses to nutrient enrichment in invasive *Glyceria maxima* and native

New Zealand Carex species. Aquatic Botany 103: 37–47. https://doi.org/10.1016/j.aquabot.2012.05.008

317. Soukup J, Holec J, Hamouz P, Tyšer L (2004) Aliens on arable land. Weed Science on the Go: 11–22.
318. Speranza PR (2009) Evolutionary patterns in the Dilatata group (Paspalum, Poaceae). Plant Systematics and Evolution 282: 43–56. https://doi.org/10.1007/s00606-009-0205-5
319. Stahlman PW, Miller SD (1990) Downy brome (*Bromus tectorum*) interference and economic thresholds in winter wheat (*Triticum aestivum*). Weed Science 38: 224–228.
320. Standish RJ, Cramer VA, Hobbs RJ (2008) Land-use legacy and the persistence of invasive Avena barbata on abandoned farmland. Journal of Applied Ecology 45: 1576–1583. https://doi.org/10.1111/j.1365-2664.2008.01558.x
321. Steppuhn H, Asay K (2005) Emergence, height, and yield of tall, NewHy, and green wheatgrass forage crops grown in saline root zones. Canadian journal of plant science, 85: 863–875.
322. Sugiura S, Yamazaki K (2007) Migratory moths as dispersal vectors of an introduced plant-pathogenic fungus in Japan. Biological Invasions 9: 101–106. https://doi.org/10.1007/s10530-006-9006-8
323. Svitashev S, Bryngelsson T, Vershinin A, Pedersen C, Säll T, von Bothmer R (1994) Phylogenetic analysis of the genus Hordeum using repetitive DNA sequences. Theoretical and Applied Genetics 89: 801–810. https://doi.org/10.1007/BF00224500
324. Sweet LC, Holt JS (2015) Establishment Stage Competition between Exotic Crimson Fountaingrass (*Pennisetum setaceum*, C4) and Native Purple Needlegrass (*Stipa pulchra*, C3). Weed Science Society of America 8: 139–150. https://doi.org/10.1614/IPSM-D-14-00048.1
325. Szczepaniak M (2009) Biosystematic studies of *Elymus repens* (L.) gould (Poaceae): Patterns of phenotypic variation. Acta Societatis Botanicorum Poloniae 78: 51–61.
326. Takahashi W, Miura Y, Sasaki T, Takamizo T (2014) Identification of a novel major locus for gray leaf spot resistance in Italian ryegrass (*Lolium multiflorum* Lam.). BMC Plant Biology 14: 1–12. https://doi.org/10.1186/s12870-014-0303-6
327. Takahashi W, Takamizo T, Kobayashi M, Ebina M (2010) Plant regeneration from calli in giant reed (*Arundo donax* L.). Grassland Science 56: 224–229. https://doi.org/10.1111/j.1744-697X.2010.00198.x
328. Takahashi Y, Aoyama M, Abe E, Aita T, Kawashima S, Ohta N, Sakaguchi M (2008) Development of electron spin resonance radical immunoassay for measurement of airborne orchard grass (*Dactylis glomerata*) pollen antigens. Aerobiologia 24: 53–59. https://doi.org/10.1007/s10453-007-9082-y
329. Tanji A (2001). Response of ripgut brome (*Bromus rigidus*) and foxtail brome (*Bromus rubens*) to MON 37500. Weed technology 15: 642–646.
330. Tanno K, Von Bothmer R, Yamane K, Takeda K, Komatsuda T (2010) Analysis of DNA sequence polymorphism at the cMWG699 locus reveals phylogenetic relationships and allopolyploidy within *Hordeum murinum* subspecies. Hereditas 147: 34–42. https://doi.org/10.1111/j.1601-5223.2009.02142.x

331. Tayyar R, Khudamrongsawat J, Holt JS (2004) Genetic diversity of giant reed (*Arundo donax*) in the Santa Ana River, California. Weed Science 52: 395–405. https://doi.org/10.1614/WS-03-120R1
332. Timbrell VL, Riebelt L, Simmonds C, Solley G, Smith WB, McLean-Tooke A, Van Nunen S, Smith PK, Upham JW, Langguth D, Davies JM (2014) An immunodiagnostic assay for quantitation of specific ige to the major pollen allergen component, pas n 1, of the subtropical bahia grass. International Archives of Allergy and Immunology 165: 219–228. https://doi.org/10.1159/000369341
333. Timko MP, Huang K, Lis KE (2012) Host Resistance and Parasite Virulence in Striga–Host Plant Interactions: A Shifting Balance of Power. Weed Science 60: 474–479. https://doi.org/10.1614/WS-D-l
334. Tozer KN, Chapman DF, Quigley PE, Dowling PM, Cousens RD, Kearney GA (2009) Integrated management of vulpia in dryland perennial pastures of southern Australia. Crop and Pasture Science 60: 32–42. https://doi.org/10.1071/CP07445
335. Tozer KN, Chapman DF, Quigley PE, Dowling PM, Cousens RD, Kearney GA (2008) Effect of grazing, gap dynamics, and inter-specific seedling competition on growth and survival of *Vulpia* spp. and *Hordeum murinum* ssp. leporinum. Australian Journal of Agricultural Research 59: 646–655. https://doi.org/10.1071/AR07375
336. Tozer KN, Chapman DF, Quigley PE, Dowling PM, Cousens RD, Kearney GA, Sedcole JR (2008) Controlling invasive annual grasses in grazed pastures: Population dynamics and critical gap sizes. Journal of Applied Ecology 45: 1152–1159. https://doi.org/10.1111/j.1365-2664.2008.01500.x
337. Travlos IS (2013) Competition between ACCase-Inhibitor Resistant and Susceptible Sterile Wild Oat (*Avena sterilis*) Biotypes. Weed Science 61: 26–31. https://doi.org/10.1614/WS-D-12-00065.1
338. Travlos IS, Giannopolitis CN, Economou G (2011) Diclofop resistance in sterile wild oat (*Avena sterilis* L.) in wheat fields in Greece and its management by other post-emergence herbicides. Crop Protection 30: 1449–1454. https://doi.org/10.1016/j.cropro.2011.07.001
339. Tushemereirwe WK (1993) First report of Fusarium wilt on East African Highland cultivars of banana. Plant Disease 77: 1063.
340. Tworkoski TJ, Glenn DM (2001) Yield, shoot and root growth, and physiological responses of mature peach trees to grass competition. HortScience 36: 1214–1218.
341. Upadhyay RK, Rai V, Tiwari SK (2014) Modeling wetland systems of Keoladeo National Park (KNP), India: the role of space. Wetlands Ecology and Management 22: 605–624. https://doi.org/10.1007/s11273-014-9355-5
342. Van der Valk AG, Middleton BA, Williams RL, Mason DH, Davis CB (1993) The biomass of an Indian monsoonal wetland before and after being overgrown with *Paspalum distichum* L. Vegetatio 109: 81–90. https://doi.org/10.1007/BF00149547
343. Vázquez de Aldana BR, García Ciudad A, Zabalgogeazcoa I, García Criado B (2001) Ergovaline levels in cultivars of *Festuca arundinacea*. Animal Feed Science and Technology 93: 169–176. https://doi.org/10.1016/S0377-8401(01)00285-1
344. Venuto BC, Croughan SS, Pitman WD, Jessup RW, Renganayaki K, Burson BL (2007) Variation among hexaploid *Paspalum dilatatum* Poir. regenerants from tissue

culture. Australian Journal of Experimental Agriculture 47: 1109–1116. https://doi.org/10.1071/EA06337

345. Vere DT, Auld BA, Campbell MH (1993) Economic assessments of serrated tussock (*Nassella trichotoma*) as a pasture weed. Weed Technology 7: 776–782.
346. Verloove F, Reynders M (2007) Studies in the genus Paspalum (Paniceae, Poaceae) in Europe-2. The Quadrifaria group. Willdenowia 37: 423–430. https://doi.org/10.3372/wi.37.37203
347. Wales WJ, Dellow DW, Doyle PT (2000) Protein supplementation of cows grazing limited amounts of paspalum (*Paspalum dilatatum* Poir.)-dominant irrigated pasture in mid lactation. Australian Journal of Experimental Agriculture 40: 923–929. https://doi.org/10.1071/EA00020
348. Walker RH, Wehtje G, Richburg III JS (1998) Interference and control of large crabgrass (*Digitaria sanguinalis*) and southern sandbur (*Cenchrus echinatus*) in forage bermudagrass (*Cynodon dactylon*). Weed technology 12: 707–711.
349. Westbrooks RG (1991) Plant protection issues: I. A commentary on new weeds in the United States. Weed Technology 5: 232–237.
350. Westbrooks RG, Cross G (1993) Serrated tussock (*Nassella trichotoma*) in the United States. Weed Technology 7: 525–528.
351. Wijte AHBM, Mizutani T, Motamed ER, Margaret L, Miller DE, Alexander DE, Journal I (2005) Temperature and Endogenous Factors Cause Seasonal Patterns in Rooting by Stem Fragments of the Invasive Giant Reed, *Arundo donax* (Poaceae). International Journal of Plant Science 166: 507–517. https://doi.org/10.1086/428915
352. Willenborg CJ, May WE, Gulden RH, Lafond GP, Shirtliffe SJ (2005) Influence of wild oat (*Avena fatua*) relative time of emergence and density on cultivated oat yield, wild oat seed production, and wild oat contamination. Weed Science 53: 342–352. https://doi.org/10.1614/WS-04-124R1
353. Williams CS, Hayes RM (1984) Johnsongrass (*Sorghum halepense*) competition in soybeans (*Glycine max*). Weed Science 32: 498–501.
354. Williams DG, Mack RN, Black RA (1995) Ecophysiology of Introduced Pennisetum Setaceum on Hawaii: The Role of Phenotypic Plasticity. Ecology 76: 1569–1580. https://doi.org/10.2307/1938158
355. Wilson MV, Clark DL (2001) Controlling invasive *Arrhenatherum elatius* and promoting native prairie grasses through mowing. Applied Vegetation Science 4: 129–138.
356. Wojciechowaka B (1984) Crosses of barley with rye, Hordeum jubatum× 4x Secale cereale and BC progenies of H. jubatum× 2x S. cereale. Cereal research communications 12: 67–73.
357. Wood ML, Murray DS, Banks JC, Verhalen LM, Westerman RB, Anderson KB (2002) Johnsongrass (*Sorghum halepense*) density effects on cotton (*Gossypium hirsutum*) harvest and economic value. Weed technology 16: 495–501.
358. Yakubu MT, Bukoye BB, Oladiji AT, Akanji MA (2009) Toxicological implications of aqueous extract of *Bambusa vulgaris* leaves in pregnant Dutch rabbits. Human and Experimental Toxicology 28: 591–598. https://doi.org/10.1177/0960327109106975
359. Yamada T (2001) Introduction of a self-compatible gene of *Lolium temulentum* L. to perennial ryegrass (*Lolium perenne* L.) for the purpose of the production of inbred lines of perennial ryegrass. Euphytica 122: 213–217.

360. Yelenik SG, Levine JM (2011) The role of plant-soil feedbacks in driving native-species recovery. Ecology 92: 66–74. https://doi.org/10.1890/10-0465.1
361. Yoder CK, Nowak RS (2000) Phosphorus acquisition by *Bromus madritensis* ssp. rubens from soil interspaces shared with Mojave desert shrubs. Functional Ecology 14: 685–692. https://doi.org/10.1046/j.1365-2435.2000.00482.x
362. Yongsheng ZHU, Baotang C, Shunwu YU (2004) Transfer of bacterial blight resistance from *Oryza meyeriana* to *O. sativa* L. by asymmetric somatic hybridization. Chinese Science Bulletin 49: 1481–1484. https://doi.org/10.1360/03wc0545
363. Yu J, McCullough PE (2014) Methiozolin efficacy, absorption, and fate in six cool-season grasses. Crop Science 54: 1211–1219. https://doi.org/10.2135/cropsci2013.05.0349
364. Yu J, Mccullough PE, Grey T (2015) Physiological effects of temperature on turfgrass tolerance to amicarbazone. Pest Management Science 71: 571–578. https://doi.org/10.1002/ps.3853
365. Yu Q, Friesen LJS, Zhang XQ, Powles SB (2004) Tolerance to acetolactate synthase and acetyl-coenzyme A carboxylase inhibiting herbicides in *Vulpia bromoides* is conferred by two co-existing resistance mechanisms. Pesticide Biochemistry and Physiology 78: 21–30. https://doi.org/10.1016/j.pestbp.2003.07.004
366. Zand E, Beckie HJ (2002) Competitive ability of hybrid and open-pollinated canola (*Brassica napus*) with wild oat (*Avena fatua*). Canadian Journal of Plant Science 82: 473–480. https://doi.org/10.4141/P01-149
367. Zapiola ML, Mallory-Smith CA (2012) Crossing the divide: Gene flow produces intergeneric hybrid in feral transgenic creeping bentgrass population. Molecular Ecology 21: 4672–4680. https://doi.org/10.1111/j.1365-294X.2012.05627.x
368. Zhang H, Ge Y, Wang M, Liu J, Si H, Zhang L, Liang G, Gu M, Tang S (2016) Mapping QTLs conferring resistance to rice black-streaked dwarf disease in rice (*Oryza sativa* L). Euphytica 212: 323–330. https://doi.org/10.1007/s10681-016-1782-3
369. Zhong S, Ali S, Leng Y, Wang R, Garvin DF (2015) Brachypodium distachyon-Cochliobolus sativus Pathosystem is a New Model for Studying Plant-Fungal Interactions in Cereal Crops. Phytopathology 105: 482–489. https://doi.org/10.1094/PHYTO-08-14-0214-R
370. Zhou B, Kong CH, Li YH, Wang P, Xu XH (2013) Crabgrass (*Digitaria sanguinalis*) allelochemicals that interfere with crop growth and the soil microbial community. Journal of Agricultural and Food Chemistry 61: 5310–5317. https://doi.org/10.1021/jf401605g
371. Zhou B, Kong C-H, Wang P, Li Y-H (2013) Chemical constituents of the essential oils of wild oat and crabgrass and their effects on the growth and allelochemical production of wheat. Weed Biology and Management 13: 62–69. https://doi.org/10.1111/wbm.12010
372. Zhou L, Hopkins AA, Huhman D V., Sumner LW (2006) Efficient and sensitive method for quantitative analysis of alkaloids in hardinggrass (*Phalaris aquatica* L.). Journal of Agricultural and Food Chemistry 54: 9287–9291. https://doi.org/10.1021/jf061819k
373. Zhu Y, Qiang S (2004) Isolation, pathogenicity and safety of *Curvularia eragrostidis* isolate QZ-2000 as a bioherbicide agent for large crabgrass (*Digitaria sanguinalis*). Biocontrol Science and Technology 14: 769–782. https://doi.org/10.1080/09583150410001720699

374. Zou L, Santanen A, Tein B, Stoddard FL, Mäkela PSA (2014) Interference potential of buckwheat, fababean, oilseed hemp, vetch, white lupine and caraway to control couch grass weed. Allelopathy Journal 33: 227–236.
375. http://aknhp.uaa.alaska.edu
376. http://dpipwe.tas.gov.au/invasivespecies/
377. http://eol.org/pages/1115814/details
378. http://explorer.natureserve.org/servlet/NatureServe?searchName=Arrhenatherum+elatius
379. http://explorer.natureserve.org/servlet/NatureServe?searchName=Cynosurus+echinatus
380. http://gri.msstate.edu/research
381. http://ice.ucdavis.edu/invasives/scorecard/avenabarbatascorecard
382. http://ipm.ucanr.edu/PMG/WEEDS/hare_barley.html
383. http://issg.org/database/species
384. http://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/Avena_sterilis_(Sterile_Oat).htm
385. http://keyserver.lucidcentral.org/weeds/data/030308000b07490a8d040605030c0f01/media/Html/Avena_barbata.
386. http://oacc.info/Docs/Quackgrass_final_rev_JD.pdf
387. http://plants.usda.gov/
388. http://www.cabi.org/isc/datasheet/10024
389. http://www.cabi.org/isc/datasheet/10029
390. http://www.cabi.org/isc/datasheet/10029
391. http://www.cabi.org/isc/datasheet/10032
392. http://www.cabi.org/isc/datasheet/10033
393. http://www.cabi.org/isc/datasheet/10036
394. http://www.cabi.org/isc/datasheet/109621
395. http://www.cabi.org/isc/datasheet/110291
396. http://www.cabi.org/isc/datasheet/112795
397. http://www.cabi.org/isc/datasheet/11872
398. http://www.cabi.org/isc/datasheet/14501
399. http://www.cabi.org/isc/datasheet/38952
400. http://www.cabi.org/isc/datasheetreport?dsid=112070
401. http://www.cabi.org/isc/datasheetreport?dsid=7065
402. http://www.calipc.org/ip/management/ipcw/pages/detailreport.cfm@usernumber=20&surveynumber=182.php
403. http://www.capetowninvasives.org.za/project/terrestrial/species/cortaderiaselloana
404. http://www.columbia.edu/itc/cerc/danoffburg/invasion_bio/inv_spp_summ/Bromus_tectorum.html
405. http://www.environment.gov.au/cgibin/biodiversity/invasive/weeds/weeddetails.pl?taxon_id=6390#
406. http://www.fao.org/ag
407. http://www.fs.usda.gov/main/r3/forest-grasslandhealth/invasivespecies
408. http://www.herbiguide.com.au/Descriptions/hg_Great_Brome.htm
409. http://www.invasives.org.za/legislation/item/228commonpampasgrasscortaderiaselloana

410. http://www.invasives.org.za/legislation/item/235-giant-reed-arundo-donax
411. http://www.invasives.org.za/legislation/item/300feathertoppennisetumvillosum
412. http://www.invasives.org.za/legislation/item/829-serrated-tussock-nassella-trichotoma
413. http://www.invasives.org.za/legislation/item/850tussockpaspalumpaspalumquadrifarium
414. http://www.iucngisd.org/gisd/species.php?sc=1315
415. http://www.iucngisd.org/gisd/species.php?sc=1399
416. http://www.iucngisd.org/gisd/species.php?sc=1418
417. http://www.iucngisd.org/gisd/species.php?sc=1419
418. http://www.iucngisd.org/gisd/species.php?sc=266
419. http://www.iucngisd.org/gisd/species.php?sc=373
420. http://www.nps.gov/plants/alien/pubs/midatlantic/bamboos.htm
421. http://www.pittwater.nsw.gov.au/environment/noxious_weeds/grasses/tussock_paspalum?SQ_DESIGN_NAME=printer_friendly
422. http://www.texasinvasives.org/plant_database/detail.php?symbol=BRCA6
423. https://florabase.dpaw.wa.gov.au
424. https://keyserver.lucidcentral.org/weeds/data/media/Html/aira_caryophyllea.htm
425. https://keyserver.lucidcentral.org/weeds/data/media/Html/briza_maxima.htm
426. https://keyserver.lucidcentral.org/weeds/data/media/Html/cortaderia_selloana.htm
427. https://keyserver.lucidcentral.org/weeds/data/media/Html/paspalum_quadrifarium.htm
428. https://wiki.bugwood.org/Bromus_tectorum
429. https://wiki.bugwood.org/Elymus_repens
430. https://wiki.bugwood.org/Glyceria_maxima
431. https://www.cabi.org/isc/datasheet/112070
432. https://www.cabi.org/isc/datasheet/114824
433. https://www.cabi.org/isc/datasheet/18916
434. https://www.cabi.org/isc/datasheet/31166
435. https://www.cabi.org/isc/datasheet/31169
436. https://www.cabi.org/isc/datasheet/81510
437. https://www.cal-ipc.org/plants/profile/festuca-arundinacea-profile/
438. https://www.cropscience.bayer.com
439. https://www.invasive.org/browse/subinfo.cfm?sub=5214
440. https://www.nies.go.jp/biodiversity/invasive/DB/detail/80850e.html
441. www.biosecurity.qld.gov.au
442. www.nies.go.jp/biodiversity
443. https://escholarship.org/uc/item/3qt3s5c4
444. http://www.aprs.iobc.info/download/20141106_Symposium/20141106_IOBC-APRS_Symposium_Sands.pdf
445. http://agris.fao.org/agris-search/search.do
446. http://indigo-dc.org
447. http://agris.fao.org/agris-search/search.do
448. https://www.cabi.org/isc/datasheet/112778

Supplementary material 1

Table S1, Table S2, Figure S1

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Data type: species data

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Supplementary material 2

Figure S2

Authors: Khensani V. Nkuna, Vernon Visser, John R.U. Wilson, Sabrina Kumschick

Data type: statistical data

Explanation note: The impact magnitude of the 48 studied alien grasses across different habitats. The impact magnitudes on the x-axis are the least-square means of the impact scores as derived from a cumulative link mixed effects model. On the y-axis are the habitat types impacted by alien grasses and in brackets is the number of species with records in that habitat. The points represent the impact magnitudes and the error bars represent 95 % confidence intervals. Letters on the right side of the confidence intervals are level groupings indicating no significant differences among the habits. Comparisons are Tukey adjusted.

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